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ELECTRIC LIGHTING EXPANSION.

There seems to be a general impression that the activity in electric lighting development was not maintained during the past year, or at least had fallen off in the past six months. We have therefore taken the trouble to make a careful analysis of the situation from the statistics available with the object of ascertaining the facts as fully as possible. This, of course, is difficult owing to the magnitude of the industry, now comprising between five and six thousand companies, and for the reason that in few States are the figures required officially; while mere incorporation is not sufficient evidence of actual work or intention to build. The returns compiled for the McGraw Electrical Directory are therefore the best first-hand data obtainable, and it is these we have taken as a basis of examination. The result is extremely gratifying and encouraging as to the growth of the industry and the vigor with which it is being pushed all over the country.

The Directory, as our readers know, issues twice a year from this office, and comprises all the private companies and municipal plants in the United States, Mexico and Canada. Two issues will therefore roughly furnish the data of one year. We are just going to press with the March number, which being a little overdue will possibly include, with the issue of last September, figures for about 13 months, as some of the reports included are very recent. It appears that the number of new companies or plants included in the September issue were 220, while the number which will be brought to account for the first time in the April issue is no less than 265. This makes a gain of 485 for the year, and 5498 for the total number at the present time. It will thus be seen that the gain during the past six months of financial and industrial depression was better than in the preceding period of strenuous prosperity.

The gain is also pronounced when the capitalization is considered. Of these 485 plants, 256 have reported their capitalization, or, if municipal, their cost or the amount of bonds issued for them. In the second six months, when 150 thus reported, the amount was $30,161,565. In the first six months, when 96 gave this item, the amount was $32,458,100, showing a marked gain even in the amount since October last with its blight on development in general. It is usually the small plants that do not report cost or capitalization, but it would not be unfair on such a showing to assume that the 229 systems not reporting would bring the $62,619,565 for the year as reported by the other 256, up to at least $75,000,000. Hence, putting aside altogether the immense amount of money spent on renewals and extensions by old systems, it is certainly a most hopeful sign of good times to see at least $75,000,000 of new capital in a bad year pledged to the expansion of the electric light and power industry. All the indications point to an increase in this rate of growth, which is distributed throughout the con-

tinent. It may be added that of the 485 new plants reporting, 441 are in the United States. We think our electrical manufacturing friends can afford to "brace up and get busy," and that operating companies will be glad to welcome so large an accession to their ranks.

Recent Magnetic Observations and Deductions.

The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has recently collected and published a table of the mean values of magnetic elements for the early years of the twentieth century, at 61 magnetic observatories. These observatories range in latitude from Pawlowsk nearly 60 deg. north, to Christchurch 43½ deg. south, and in longitude from Christchurch 172½ deg. east to Hawaii 158 deg. west. The horizontal magnetic density is recorded as a maximum at 0.387 gauss in Taungoo, British Burmah. Apparently this is the only claim of that locality to distinction; i. e., the compass needle aligns itself there more forcibly than anywhere else. The recorded minimum is 0.155 gauss at Sitka. The secular movement of the earth's magnetic poles continues to puzzle magneticians and to baffle explanation. The late Lord Kelvin used to dilate upon the wonder of this remarkable migration. We are informed by astronomers that the earth's terrestrial poles wander more or less, so that a stake driven into the ground to mark the position of the true terrestrial pole on a certain date, would soon become excentric. But the wandering of the earth's terrestrial pole is a small matter—so small that it has only been detected in recent times—and the stake would not usually roam outside of a one-acre lot, if the lot could be laid off on the surface of the ground. Moreover, the south pole is subjected to corresponding symmetrical meandering, the polar axis always being taken as a straight line connecting the poles through the earth's center.

In contradistinction to the behavior of the magnetic poles, the geographic poles are models of stability. It is hard even to define what shall constitute the earth's magnetic poles. If, in accordance with custom, we take the localities where the dipping needle stands vertical, their positions will be definite but dissymmetrical on the globe. If we take the point where the earth's magnetic axis intersects the surface, we may obtain diametrically opposite points; but we find them distinctly displaced from those indicated by the preceding definition. Even the magnetic axis is hard to define. But whatever definition we select, the earth's magnetic poles wander from decade to decade at a speed of something over a mile a year. According to the deductions of one well-known magnetician, based only on observations of declination extending over three centuries, the north magnetic pole has worked its way southward from latitude 82 deg. north to 69 deg. north about the year 1800, in longitude roughly 90 deg. west, or in the vicinity of the Gulf of Bothnia. Having thus nearly worked its passage to the edge of the Arctic circle, it changed its direction rather suddenly and is now retreating northward again not far from its line of previous advance.

It is now believed that the earth's magnetism is divisible into three parts; first and greatest a part due to internal actions, or conditions beneath the earth's crust; second, a part due to external actions, or such as might exist in and above the atmosphere; and third, a portion attributable to electric currents upward and downward in the atmosphere such as might be due to movements of air carrying electric charges. It is pointed out by Dr. Bauer that no analysis of the secular movement of the earth's magnetic poles can be reasonably complete without differentiating the movements of these components. In regard to the mean diurnal swing of the declination at different points of the earth's surface, a curious fact has been substantiated recently in accordance with what is known as Bauer's law; namely, that the range increases with the magnetic latitude, being inversely proportional to the plane area enclosed by the latitude circle. Stations like Grinnell Island, at a high magnetic latitude, show a mean daily range of declination of about 1½ deg., so that the compass needle will daily swing through this angle on the average; while stations like St. Helena, at a low magnetic latitude, show a mean daily range of only about 1/30 of 1 deg. in declination. Observations made at Teplitz Bay on the far northwestern coast of Greenland, during a certain magnetic storm of October, 1903, showed that the declination varied over 17 deg. in about 100 minutes. This large and rapid variation, if it occurred in lower latitudes, would be likely to frighten a navigating officer on board ship into mental aberration. Fortunately, few ships navigate within the Arctic circle, and violent magnetic storms are rare.

The Design of Electromagnetic Brakes.

The electromagnet is now a well-known substitute for the arm of an attendant in a machine so situated that an attendant cannot conveniently be set over it. The attendant is situated instead at some remote point, and closes a circuit through the plunger electromagnet on the machine. The plunger immediately proceeds to exert a pull of from 1 lb. to, perhaps, 100 lb. weight, over a distance of from ¼ in. to, say, 6 in., according to the size and design of the electromagnet. In particular, the electromagnet has come into extensive use in connection with electric hoists, cranes and elevators, either for operating distant switches or for applying electromagnetic pulls to brakes, or for both these purposes. In every such electromagnetic mechanism, the underlying law of force is capable of very simple expression. Each square inch of opposed polar surface exerts a magnetic pull, perpendicular to its face, directly proportional to the square of the flux density. In simple forms of electromagnets, it may be easy to compute the flux-density and also the total surface area and total resultant pull. In many practical instances, however, complex shape of the parts, and the varying degree of saturation of the magnet, make the computation hopeless from an engineering standpoint, and it becomes necessary to resort to rough approximations and empirical methods

Mr. J. Nikonow's article this week, on page 811, discusses the design of electromagnetic brakes with reference to particular well-known types that have come into practical use. In hoisting mechanism it is often preferable to make the electromagnet remove the brake when excited, and set the brake when unexcited, for the reason that if any electrical accident should occur, the brakes will set automatically and prevent the possibility of damage by failure to brake. Such an electromagnet must, however, be kept excited all the time the machine is running, and this is a disadvantage that may turn the scale in favor

of the opposite mode of operation. The efficiency of any such reciprocating electromagnetic mechanism must always be very small. In no case does it seem possible to secure an efficiency exceeding 50 per cent, whereas 2 or 3 per cent is a more common ratio of the useful mechanical work done to the electrical energy received. Consequently, an electric motor substituted for a reciprocating electromagnet could always be made more efficient. But, as pointed out in the article, the amount of work to be done by such an electromagnet is usually very small, so that the efficiency is of very little consequence; while the relative simplicity and directness of an electromagnet far outweigh the energy saving of an electric motor for ordinary brake-setting operations.

It is pointed out that an alternating-current electromagnet has the interesting and often useful property of developing a much larger reactance at the end of its stroke than at the beginning. This means that after the magnet has done its work and pulled up its plunger, the alternating-current strength which it receives is greatly reduced automatically. In the case reported near the end of the article, the current strength at the end of the stroke was 14 times less, and the copper heating, therefore, 200 times less, than at the beginning of the stroke. This means that such magnets do not require the injection of resistance into their circuits in the same manner that direct-current electromagnets so frequently require it. Moreover, for the same reason, the pull of an alternating-current electromagnet with plane poles may be nearly uniform throughout its stroke, whereas the pull of the same type of electromagnet operated by direct current is very much weaker at the beginning than at the end of the stroke.

The Growth of a Transmission Network.

The transmission system around Portland, Ore., is an excellent example of the upbuilding of a power transmission plant in response to the needs of a growing city. It is in fact one of those cases in which growth is bound to continue, since Portland seems certain to occupy a position of ever-increasing importance on the Pacific Coast. The Falls of the Willamette, at Oregon City, till recently the chief source of electric power for Portland, were early developed. The situation was such that a fair supply of power could be obtained by a dam that was scarcely more than a low crest wall at the head of the fall. A small lighting plant was established here rather early in the days of alternating current working—the predecessor in business of Station B. Plans for this station were made in 1893 and it was, when completed a couple of years later, not only one of the very early three-phase transmission plants, but, if we remember correctly, the first American station to use high-voltage generators. Up to that time the practical limit of generator voltage here was about 3000 volts and no large machines had been worked even at that modest figure. In the original equipment of what is now Station B the machines were wound for the then extreme and precarious figure of 6000 volts, with revolving armatures at that, the revolving-field machine being still in American practice looked upon as a questionable innovation.

The frequency of 33 cycles used in this station is also of significance as a bit of ancient history. The plant was laid out in the helpless infancy of the rotary converter. Everybody revolted at designing a rotary for 50 cycles or 60 cycles on account of difficulties of commutation, and it was well known that incandescent lighting at 25 cycles, a frequency commonly used for rotaries, was bad if not quite intolerable. The frequency of 33 cycles was therefore a compromise between the requirements for synchronous converters and those for incandescent lighting. It proved a satisfactory figure and still persists, almost the only one of its kind, just as the early Redlands plant in southern California has impressed its frequency of 50 cycles upon the whole huge network there—all of which goes to show that frequency within moderate limits is really a matter of small moment. To this initial hydraulic plant at Oregon City has recently been added the five stations at Cazadero on the Clachamas River. This is a typical modern hydraulic plant with three 2500-kw three-phase generators directly coupled to horizontal turbines working under a head of 138 ft. The generators are for 33 cycles, like those in the original plant at Oregon City, and give directly 10,000 volts, stepped up to 33,000 for the 31-mile transmission into Portland. The B station on its part not only feeds Portland, but extends its lines up the Willamette Valley at 30,000 volts, reinforced by a steam station and a small hydraulic plant. Substations here and there feed the whole valley and the electric roads of the neighborhood. A third section of the same great distributing plant occupies Vancouver just across the Columbia River. This is operated by a steam plant at 60 cycles.

The inconvenience of a low-frequency supply for lighting purposes is evidenced by the fact that the lighting over the territory covered is almost entirely at 60 cycles, obtained by motor generators from the original 33 cycles. Fortunately the railway is so considerable that the loss from this transformation is in part offset by the greater convenience of the low-frequency rotaries. In the long run it appeared that while incandescent lighting at 33 cycles was perfectly good, it entailed so heavy a cost of special transformers that frequency-changing was the best way out of the scrape. Just at present the upper Willamette Valley, the lower Willamette Valley (including Portland) and the Vancouver systems are physically separate, but the final step of building interconnecting lines is soon to be taken and thenceforward a great network will be built up to do for western Oregon what the two immense plants to the southward have done for California. There is no field of endeavor in which great combinations do work of more general and conclusive value than in electrical generation and transmission. This does not mean merely the construction by a powerful company or the biggest known station yet built, but the coherent union of the natural resources of a great territory to be used for its good. An interconnected network of electrical generating plants, whether steam or electric, can do in efficiency and reliability what no one plant can reasonably hope to accomplish. It can supply its territory with less loss and more cheaply; it can take advantage of the locations where cheap fuel or water power is most available, and it may even gain the combined storage capacity and security of two watersheds. The big Oregon system we are here considering is only one of a group of great enterprises that have made the Pacific Coast notable and have taught the world a lesson in engineering that will not soon be forgotten.

Power Plants Affected by Government Regulation.

Mr. William G. Kerckhoff, of Los Angeles, general manager of the Pacific Light & Power Company, of Los Angeles, and prominently connected with H. E. Huntington in his power interests at Fresno and other southern California cities, recently gave an address before the Chamber of Commerce, at Fresno, in which he said that the attitude of the national administration on the power question would have the effect of preventing further development. "As things now stand we will simply conserve such power plants as we have, but will not undertake any large new developments. We object to regulation only when regulation makes it impossible for us to obtain capital for development. If capital will look favorably upon it, the question is simple enough. Electrical development has attracted capital as a profitable kind of investment and money was flowing regularly into these big enterprises. Suddenly the government steps in and imposes certain restrictions, such as a 40-year lease, and hedges the privilege about with other charges that cannot be definitely determined in advance, and capital has halted. This is exactly the fix in which we now find ourselves.

"Of course, whatever additional expense there is in the generation of electricity, whether government charges or what, must ultimately be borne by the consumers. That is, up to the point of competition with electricity generated by coal, oil or other fuel. As soon as electricity can be manufactured cheaper than it can be made available by long-distance transmission, we will have to shut up shop and go out of business. That is a simple business fact. Even now in our contracts for electric power for pumping and other purposes at $40 and $50 a hp-year we have protected ourselves with a clause imposing the government charge upon the consumer." Mr. Kerckhoff stated he believed that in time the government authorities would look at the matter of power charges in a light that would again appeal to capital.

Mr. Frank H. Short, attorney for the power company, who made two trips to Washington in the interest of the power companies on the water charge issue, stated that some weeks ago all hope of getting a bill through Congress satisfactory to the power interests had been given up, on account of President Roosevelt's outspoken opposition to all such measures.

New York Central Overhead High-Tension System.

Mr. E. B. Katte, electrical engineer of the New York Central Railroad, at an adjourned hearing on Thursday, April 9, before the New York City Public Service Commission, continued his testimony on the subject of the overhead high-tension system of the New York Central. He stated that the cost of putting underground duct lines for the system from Putnam Crossings to Kingsbridge substation, and from Kingsbridge substation to a point 350 ft. west of Broadway, a distance of about 3.4 miles, would be $608,000, including the cost of taking down present lines. His second estimate for putting the system in tile ducts from the substation at Kingsbridge to a point 350 ft. west of Broadway, gave a cost of $120,000, the distance being about three-tenths of a mile. Mr. Katte testified that there were 513 miles of aerial pole lines in Greater New York, carrying voltages from 1000 to 3000 and 47 miles with voltages from 6000 to 11,000. Of the 513 miles there is but one mile in Manhattan, 130 in Brooklyn, 80 in the Bronx, 132 in Queens, and 150 in Richmond. None of the 47 miles of high-voltage lines is in Manhattan, 15 miles are in Brooklyn, 12 in the Bronx, 20 in Queens and none in Richmond. After giving in detail the cost of the subway construction in the places mentioned, Mr. Katte said that to his knowledge there have been only two fatalities from the present overhead system, namely, those of two boys who had climbed the poles and were killed.

Mr. Katte said that practically no trouble had been experienced with the overhead lines, but that there had been several short-circuits on the 11,000-volt underground cables. The question of the proper limits of a voltage test on a cable was discussed at some length, and the matter of proper insulation of cables was also taken up. Mr. Katte said that there had been no difficulties experienced in the last two summers from lightning. The circuit-breakers are set to open instantly on a short-circuit of 800 amperes and at about three seconds on short-circuits of 500 to 600 amperes. He said that the first consideration that led the Electrical Commission to adopt the overhead system was reliability of service rather than economy.

The commission, attorneys and expert witnesses inspected the system on Saturday, and another hearing has been fixed for April 16.

Educational Courses for Central-Station Employees.

On Friday evening, April 3, the Brooklyn Edison Company completed its second year of educational work under the direction of Prof. Sydney Whitmore Ashe. The topic of the last lecture was alternating current measurements. The course this year was similar to that of last year, consisting of experimental lectures, except that the number of lectures was increased from 12 to 20. The course was this year given under the direction of the Edison Club. The interest last year was so great that 120 of the club members came together and pledged $3 each as a contribution toward the expenses of this year's course, the balance of the expense being made up by the Edison Company. The attendance was then limited to those who were interested enough to contribute to the work, the result being an average attendance which was not so great as last year, but the attention was more earnest. In giving the lectures, an attempt was made to show the direct application of the experiments to the company's methods. This scheme proved very successful and in carrying on the work another year this method will be followed to a still greater extent, the entire lecture course to be devoted to the company's apparatus and methods.

It is realized that in giving experimental lectures on the Edison Company's apparatus, it would be well in the last 15 minutes of each lecture to have a department head conclude the lecture, bringing out such operating features as had not been dwelt upon by the professor in charge. In this manner both the theoretical and practical side of the subject would be touched upon. There are quite a number of employees of the Edison Company who have attended all the lectures given by Professor Ashe at the Edison Club during both seasons.

The course of experimental lectures on electrical engineering, given during the past winter by Professor Ashe before the employees of the New York Edison Company, was completed on March 25. This course, one of the most extensive of its kind ever undertaken, registered a total attendance of 5956 men. The course consisted of 20 original lectures, five of which were repeated, making in all 25 lectures. The lectures were given weekly, each lecture being delivered at 1:30 p. m. and 8 p. m. on the same day, so as to afford all employees an equal opportunity to attend. The principal feature of the lectures was the experimental demonstrations which developed each step in a practical way as the course progressed. This maintained the interest of the men to a marked degree. As an example, several standard books on electrical engineering having been selected by Prof. Ashe and referred to from time to time during the lecture course, about 130 of these books were purchased by the men for home study. Several sets of these books were purchased by the management of the Edison Company and placed in the library for reference, where they were in frequent use. The course as a whole has done much to stimulate the enthusiasm of the men, to create in them an interest toward self-development, and to instill many of the operating features and fundamental principles of the company's apparatus.

Public Utility Commissions.

At the meeting of the American Institute of Electrical Engineers held on April 10, Mr. Henry Floy presented a paper entitled "The Engineer's Activity in Public Affairs—Public Utility Commissions and Franchise Valuations." Mr. Floy commented upon the comparatively unimportant public part taken by the engineer and the lack of public recognition of his work. The engineer's inconspicuousness was attributed to his keen interest in the purely scientific aspect of the enterprises with which he is connected, his natural hesitancy in pressing his own claims to recognition, his lack, in the past, of a broad general education and his too frequent inability to speak fluently in public.

By reason of the work and position of the engineer in the business and technical world, it is reasonable to expect that at least one-half of the membership of the public utility commissions, being named from time to time throughout the country, should be composed of experienced broad-gage engineers. The commercial importance of the engineer is steadily growing, and he should recognize the claims upon him to take part in public affairs and assume the responsibility more and more laid upon him of leadership. His increasingly closer business relations with public matters and his reputation for integrity give his opinion and influence steadily greater weight in large affairs, which he should appreciate, accept and respond to.

With regard to operation, public utility commissions should restrict their action to general principles; they should not interfere with details, otherwise they will remove the present responsibilities from the shoulders of the directors to their own shoulders, restrict and hamper the efficacy of the organizations, still the incentive to work and destroy the reasons for promotion of the employees—all of which will result in depreciating the service rendered the public and the financial standing of the corporations themselves.

In referring to franchise valuation, Mr. Floy suggested that a franchise can in most cases be valued at one-third of the actual replacement cost of the corporation's assets. For example, if the legal rate of interest is 6 per cent and the investor is unwilling to accept less than 8 per cent, a franchise valuation of one-third of the investment allows him simultaneously to receive 8 per cent on his outlay and accept 6 per cent on the total capitalization.

Mr. George S. Coleman, counsel of the Public Utilities Commission of the First District of the State of New York, said that a public service commission should be made up of men who are intelligent, open-minded, have had some experience in affairs, are patient, are thorough, industrious and who, above all, have good judgment. Such men may or may not be engineers, and it is certainly not essential for them to be engineers. Mr. Coleman expressed the opinion that the time has come when bodies of engineers should give the benefit of their concerted thought and action to any public question on which they are especially well informed. Engineers, as a class, have, in the past, been too modest.

Mr. Charles F. Lacombe, chief engineer of the Light and Power Department of New York City, stated that there should be some engineering representation on the Public Utility Commissions. A commission dealing largely with engineering subjects, made with a proper representation of lawyers, engineers and business men, would be of more value than one in which either element was left out.

Mr. H. M. Brinkerhoff, consulting engineer, remarked that public utility boards and railroad commissions should have upon them some experienced men who cannot be fooled and who will not ask the impossible. If matters be discussed in a fair, candid manner better results will be obtained than by the formal legal methods now pursued.

In a written communication, Mr. L. A. Ferguson expressed the opinion that public service corporations would be satisfied with a lower rate of interest upon their investments where their rates and other business dealings with the community are controlled by a commission composed of trained engineers than they would deem satisfactory if their rates and other business dealings were controlled, as they are now, by State Legislature or Boards of Aldermen.

Mr. H. L. Doherty, in a written communication, stated that a commission cannot do either intelligent or effective work without engineering advice or assistance, and in selecting proper commissioners the engineering fraternity should not be overlooked as a very likely source of the best available timber.

Mr. W. W. Freeman said that he would regret exceedingly to have it appear that the American Institute of Electrical Engineers advocates any plan that involves a limitation of the gross income of the company to its expenses, plus the amount which would be required as the minimum reasonable distribution to its stockholders.

In closing the discussion Mr. Floy said that a commission should protect the interests of the corporation as well as of the public, and if investors are assured of protection they can be interested in a 6 per cent return, although in the past corporations have not been able to obtain money on that basis.

Natural Illumination.

Mr. J. J. Sorber read a paper before the Chicago section of the Illuminating Engineering Society, April 9, on "The Relation of Direction of Light to Human Construction." He argued that there was some relation between the fact that man walks upright and the fact that his activity is greatest when the sun is high in the heavens. From this he drew the conclusion that artificial illuminants should be in large units and placed high rather than in the shape of "small suns" hung low at numerous places around a room. He also suggested that in selecting colors for walls of rooms it would be well to remember that outdoors nature usually provides landscapes of restful colors, such as green, grays and browns and blue sky.

Mr. George C. Keech, in the discussion, said that one of the practical advantages which, in his observation, had been obtained by the use of large units placed high in accordance with Mr. Sorber's suggestions is the avoidance of great contrasts in the illumination at various parts of a room or object. For example, a desk may be very brightly illuminated at one point with much less illumination at another. Sudden and frequent changes from highly illuminated to less illuminated surfaces are detrimental to the eye, according to the testimony of oculists at the February meeting.

New York City "Break-Down Service."

As a result of the investigation conducted by Commissioner Milo R. Maltbie, of the New York City Public Service Commission, and according to the recommendations made by him in a preliminary report to the Public Service Commission, the New York Edison Company has modified its rates for "break-down service" so that the charge shall be based upon the maximum demand of the consumer and not upon the full capacity of his installation. This agreement is to last for one year, during which time it is also agreed the company will place recording devices upon every break-down connection and take the records of the current furnished under the supervision of the commission for determining a fair service charge.

Commissioner Maltbie finds that a satisfactory decision of the rate question cannot be made until such records are taken and he recommends that the work be carried out and that the electrical engineer of the commission be instructed to supervise it. The fact that no such records have been taken in the past makes it impossible to arrive at a just and adequate charge for this kind of service.

The report points out that "break-down service" includes three kinds of service:

1. The service supplied by the company to a private consumer having his own plant when that plant breaks down and is unable to produce the current required by the consumer.

2. Auxiliary service supplied to private consumers using current at nights, on Sundays and holidays, and during periods when a small amount of current is used as compared with the total installations.

3. Peak load service—additional current furnished to private consumers at that hour of the day when the peak load or the maximum demand from all consumers occurs.

As to the first class of break-down service, the report says it is probable, in view of the comparative infrequency of complete disability, that the actual demands made upon the supply company would be very few and would not involve great expense, either in the way of fixed charges upon the duplicate plant kept ready for use, or in the way of operating charges for units revolving slowly.

In order to furnish such a service the supply company must provide merely the distribution system and the service connections for the maximum load to be demanded at any one time, and such apparatus in the generating and substations as would be equivalent to the private plants disabled at any one time. It is not necessary to duplicate the total installations of the private plants, but merely such a portion as would be at any one time out of use.

To supply the second class of consumers, says the report, the supply company would need to provide the necessary service connections and distribution lines for each user, but as current would be demanded when the stations of the company would otherwise not be operated, at their maximum capacity, it would not be necessary to provide station equipment specifically for this service; it might be necessary to keep certain units revolving slowly, but in this respect the service would not differ from the ordinary service, where there must be constant readiness to serve in excess of the demand at that moment.

The third kind of service, the report continues, is the most expensive of all, for if any restriction were placed on the amount of current consumed or the time of its use, breakdown consumers could easily so plan their equipment that they would have sufficient capacity to supply all the current required, except during the peak hours of the day. When the peak load began to come on, the breakdown user could take sufficient current from the supply company to handle this peak, breaking the connection when the peak hour passed and the consumption again became normal.

Inasmuch as the peak period for the breakdown consumer is apt to be the peak period for the supply company, this would mean that the company would be called upon for a considerable amount of current during the short period when the demands of the ordinary consumers are at their height. Thus the supply company would be obliged to maintain a considerable plant during the whole day, in order to supply the breakdown consumer during one or two hours and to carry the surface plant throughout the year, in order to handle the winter maximum due to the short period of daylight and cloudy weather.

Commissioner Maltbie concludes that a charge based upon installation and not upon the maximum demand would be generally unjust. After several conferences the representatives of the Edison Company agreed to change this charge so as to base it on the maximum demand, instead of on the total installation of private consumers. The breakdown rate as now agreed to, therefore, will be a service charge of $30, including the supply of electric light at the best rate of the class for each kilowatt of maximum demand for which the consumer may make written request to the company, and which maximum demand is to be the basis of a year's contract. The company puts this rate into effect for one year, with the privilege of withdrawing it at the end of that time if it is found to be unsatisfactory.

Eastern Association of Physics Teachers.

A largely attended meeting of the Eastern Association of Physics Teachers was held at the Worcester Polytechnic Institute on March 28. The morning session was first addressed by Dr. Charles P. Steinmetz, professor of electrical engineering, Union College, Schenectady, N. Y., and consulting engineer of the General Electric Company. His subject was "The Teaching of Science." Dr. Steinmetz emphasized the fact that engineering is applied physics, and devoted most of his attention to the defects in the present methods of teaching as evidenced by the work of young engineers that has come under his observation. Only a relatively small part of the knowledge at present taught can be retained by a man, and so the tendency is to remember disconnected individual experiences and isolated facts, more in the nature of recipes. Thus, a man will recall the equation of a falling body, while he forgets the underlying general law, being unable to apply this general law to a problem in connection with the issuing of a steam jet from a turbine nozzle. The theory of periodic vibrations is similarly not connected with light and sound in studying hydraulic problems.

Dr. Steinmetz pointed out that different forms of the same law are not recognized, and that men find cases in practice outside the region of their school work difficult to handle. Great difficulty in observing is another trouble that needs remedying. Many young graduates of the present-day training have never, for instance, counted the frequency of the waves on the ocean or lake under different conditions. One of the first duties of the observer of periodic motion is to count this frequency. At the time when considerable trouble was being experienced by the manufacturers of synchronous motors from surging or hunting, over and over again it happened that men sent out from the factory to study the matter failed to count these surges in a given time. The trouble is that we try to teach too much, and it cannot all be digested. We try to teach the student everything that he may possibly meet in practice and this cannot be done, even approximately.

There is not time enough to teach the fundamental laws and their relations. Few threads tie together the different bodies of knowledge, and these are soon broken, with the result that more or less of the knowledge passes into oblivion. We must have plenty of references and cross-references in order to use any file of knowledge. The great underlying laws of the conservation of energy, gravitation and central motion should be taught thoroughly first, rather than special applications. The main problem in engineering is to find ways of calculation and methods of doing things, applying general laws to individual phenomena.

The object to be sought in teaching is to get the maximum efficiency out of the student. The best progress of the able student should not, as is too often the case under American conditions, be sacrificed to the attempt to force along the man without aptitude for engineering. It is better for him and for the world at large that he should drop out and go into something for which he has a natural bent. In this country the born engineer does not get as much out of his college course as he ought, because of the attention paid to inferior men. The teaching force is overloaded in trying to push along the student not fitted to take up engineering.

Dr. A. W. Duff, professor of physics at the Institute, then showed the convention Braun's apparatus for illustrating the resonance of electric waves, the Glimmer oscillograph for showing the wave forms in the secondary of an induction coil, Boy's gravitation balance for finding the mean density of the earth and constant of gravitation, and the molybdenite block method of rectifying a telephonic circuit.

In the afternoon the meeting was addressed by Prof. Harold B. Smith, of the department of electrical engineering at Worcester, the subject being high-voltage power transmission. The lecture was illustrated by lantern slides and experiments involving the use of potentials between 200,000 and 250,000 volts. This was thought to be the first time that such high potentials have been used in a lecture room. The high-voltage service was supplied from a large transformer located in the basement of the high-potential laboratory, the fine wires of the transformer secondary being led to the lecture room through Locke multiple vitrified clay bushings.

After Prof. Smith's lecture the association was shown the car-testing equipment of the general electrical laboratory in service. This consists of a complete double-truck four-motor interurban car mounted on wheels carried by axles which transmit the power to special electric absorption dynamos.

Work of the Public Service Commission.

An examination of the work of the Public Service Commission of the First District of New York (New York City), at the end of the first nine months of the commission's existence, shows that in the departments of gas, electric light and power there has been much activity. Formerly gas and electric meters had been tested in a slipshod way, and to correct this the commission organized a staff of inspectors provided with proper seals, and the work of inspection was laid out systematically. During the first six months, from July 15 to Dec. 27, 1907, the commission tested in all 127,846 meters, of which 44,227 were new meters, 82,057 repaired and removed meters, and 1562 tested on complaints of consumers. Of the 1562 tested on complaint, 203, or 13 per cent, were found to be correct; 211, or 13½ per cent, were less than 2 per cent fast (the limit allowed by law); 598, or more than 38.3 per cent, were 2 per cent or more fast, and 550, or 35.2 per cent, were slow. The average of the fast meters was 3.43 per cent fast and the average of the slow meters was 2.89 per cent slow. For the three months ended March 31 last the commission tested 81,681 meters, which added to the total for the preceding six months gives a grand total of 209,527 during the first nine months of the commission's life. Of 2805 meters tested on complaint since Jan. 1, 324 were correct, 1820 were fast and 661 were slow. The average per cent of the fast meters was 3.4 per cent fast and that of the slow meters 2.3 per cent slow for the three months.

The commission is conducting an investigation of the contracts made and service given by electric light and power companies and has taken up the matter of a uniform system of accounting for the light and power companies. As a result of the investigation of "breakdown" service the New York Edison Company has made pronounced concessions and accorded rates much more satisfactory to consumers than the former rates. The New York Central Railroad has been called upon by the commission to justify the installation of the overhead high-tension system of wires which are used in the operation of its electric system.

Electrical Show at the University of Illinois.

For a second time the electrical and railway students of the University of Illinois have carried out a most successful show on March 26, 27 and 28. The university community had its curiosity aroused for some days in advance by the flashings of a searchlight from the tower of University Hall, by the interior illumination of the handsome library tower and an arrangement of apparently revolving lamps on the military flagstaff, visible for miles around. These signs, together with other more usual advertising methods, served to bring crowds to the Electrical Laboratory on the three evenings which taxed the capacity of the building. The record shows 1925 paid admissions. The three floors of the laboratory were given over to the students' exhibits. In the basement was a complete lighting plant of one arc and several incandescent lamps run by a small dynamo driven by a gasoline engine, to illustrate the ease with which a country house may now be equipped with electricity. Other electrical house features, such as all varieties of cooking and heating apparatus, were well shown on the second floor by young ladies, who served electric candies. The welding of iron, and the vagaries of high-frequency current, especially in the production of vacuum-tube lighting, were not only shown, but carefully explained.

The main laboratory floor was flooded with incandescent lamps hung in long festoons, dispensing with the usual arc lighting of this space. This special lighting gave a very attractive effect, modeled somewhat after the lighting scheme used in the Electrical Show in Chicago last January. Exhibits here included complete wireless stations, where messages were actually sent as presented by visitors, the received copy delivered from the receiving station serving as a souvenir of the occasion. Two electric incubators in operation were arranged to show that alternating current may be expected to produce speckled chickens and direct current only a black variety. The drilling of a ½-in. iron plate by means of the electric arc was one of the exhibits that attracted great attention. A house receiving dangerous strokes of static electricity was shown to be fully protected by a lightning rod that could be slipped into position. A cleverly concealed electric motor within a pulley of unsuspicious appearance running under a sign, "Perpetual motion at last. No stock for sale," created much interest and favorable comment.

An electrical blue-printing establishment and a photograph gallery were in constant operation. One of the attractive exhibits was a handsome equitorially mounted telescope where the "moon" was made visible. A miniature electric railway was shown in operation, and the stimulation of plant growth by electricity, though exaggerated to an extent amounting to a burlesque, maintained crowds in constant attendance. A newly installed substation consisting of a motor-generator set for the production of either direct or alternating currents for laboratory use was made a feature. This set was actually supplying the energy needed for the various exhibits.

A fine display of tungsten, as compared with other lighting by arc and incandescent lamps, occupied the Illumination Room up-stairs. There was also shown a motor in rapid rotation by "static electricity." A good exhibit of X-rays and a demonstration of cutting lines of force were included in the display of the

GENERAL VIEW OF MAIN FLOOR EXHIBIT.

Department of Physics. A carefully arranged telephone room showed very clearly the difference between manual operation of the usual switchboard and automatic operation.

The electric and dynamometer test cars of the railway department were open for inspection, and the electric car was arranged so that any one could "make the wheels go round" by handling the controller. Too great acceleration was prevented by the use of an e.m.f. of only 110 volts for this occasion. The car was jacked up so as to allow the wheels to revolve.

The show was a revelation to visitors as to the executive ability that may be found in apparently inexperienced students when they are allowed full sway. The admission charge was for the purpose of establishing a loan fund for electrical students, and a good start was made in this direction. Experience gained by the student-managers of the show and by all connected with it will doubtless be of direct benefit to them in the way of self-confidence when they are called upon later to take charge of business enterprises. That it was carried out with entire success and the absence of any unfavorable criticism speaks well for the boys. Everything was in readiness on the opening night, which is more than can be said of some exhibition enterprises. The appointment of sufficient "conductors" to guide visitors desiring their services was again a feature of the show, making it easy for all visitors to quickly find any desired feature that had been announced.

N. E. L. A. Convention.

An efficient system of registration of visitors to the coming Chicago N. E. L. A. convention has been organized. Cards are being sent to members, to be filled in for return by mail or presentation at Chicago. The system is similar to that which last year gave excellent results.

Mr. H. J. Gille, of the Minneapolis General Electric Company, will have charge of the presentation on "Commercial Day" of the topic, "Preparation of a Campaign," and Mr. L. A. Ferguson will similarly take care of the topic, "Relation Between the Engineering and Commercial Departments." The first-mentioned paper will have five sub-titles, as follows: (a) Field Work and Other Essentials; (b) Analysis of Customers' Accounts; (c) Proportion of Lamp Equivalent Lost to Lamps Connected—Showing Percentage in Cities of Varied Population; (d) Policy of Handling Complaints; (e) Policy of Handling Collections. Contributions to the development of the topics will be obtained from a number of experts selected from communities where conditions are widely varying.

President Roosevelt on Water Powers.

In a special message to Congress, on April 13, President Roosevelt pointed out that there are bills pending which propose to give away without price rights to streams equal to developing 1,300,000 horse-power. The President made the deduction that this practically meant the free gift of 25,000,000 tons of coal a year, and he followed this with the comment: "This natural wealth is the heritage of the people. I see no reason for giving it away."

The President sent the message in vetoing a bill extending by three years the time given to the Rainy River Improvement Company to build a dam in the Rainy River. He held that these stream privileges should be leased. He expressed the belief that natural resources should not be granted and held in an undevoloped condition either for speculative or other reasons. He said that the provision for a charge is of vital importance, that the income from charges would "materially aid in the complete improvement of our navigable waters for which there is now such crying need." He said that there is every reason for not imposing conditions so burdensome as to prevent the utilization of the power, but that "we are now at the beginning of a great development of water power, and that already the experience of the past shows the necessity of caution in making unrestricted grants of this great power." It also was said by Mr. Roosevelt that "already the evils of monopoly are becoming manifest."

The President laid down a policy in five clauses. The first for a limited grant, the second for power to annul the grant if plans are not carried out as provided in contract with the government. The third clause was for an officer to see that navigation and power are developed to the maximum. The fourth provides for a license fee or charge, and the fifth terminates the grant at a definite time.

Electric Service and the Fire at Chelsea.

Early in the progress of the fire which on April 12 destroyed over $6,000,000 in property at Chelsea, Mass., and several lives, the local street railway service of the Boston Elevated Railway Company and the Boston & Northern Street Railway Company through Chelsea was suspended. The Boston Elevated car house, at Broadway and Gerrish Avenue, was destroyed at an estimated loss of $50,000, and the Bellingham car station of the Boston & Northern Road was burned, at a loss of about $10,000. The Boston Elevated Company was able to save the cars in the city of Chelsea, by active work in the face of the fire's advance. The loss to the Boston & Northern is estimated at about $26,000, a large part of which is represented by overhead feeders and pole line fixtures. The tracks were also considerably damaged. In some places the heat of the fire was so intense that 9-in. girder rails were warped out of their foundations and broken.

Up to Monday noon the Boston Elevated Railway Company had not been able definitely to determine its losses on wires, poles and tracks. Seven snow ploughs were burned in the fire. The Boston & Northern lost but one car, it is believed. Soon after the fire got under way the Chelsea exchange of the New England Telephone & Telegraph Company was burned at a loss estimated at $20,000, and a little later the electric light and power service of the Chelsea Gas Light Company was cut off in order to prevent danger from live wires. The loss to this company is largely a loss in earnings in the burned district, for most of the electricity sold in Chelsea is supplied by the Edison Electric Illuminating Company of Boston, distributed locally by the Chelsea organization.

The wire service in Chelsea was a complete wreck, but while the ruins were still smouldering, linemen were set at work by the telegraph and telephone companies in an effort to re-establish communication. The New England Telephone & Telegraph Company had a load of lumber on hand at the site of its burned building on Fourth Street on Monday morning, and a temporary shelter was planned to be erected by night for that service.

Largest Single Telephone Installation in the World.

With a capacity of 3000 pairs the telephone installation in the new Terminal Buildings, Cortlandt and Fulton Streets, at the Manhattan end of the tunnels of the Hudson Companies, is the largest of its kind ever put into any office building in the world, exceeding by nearly 200 per cent the next largest office installation, that in the Broad Exchange Building, New York, which has 800 direct lines, and by 100 per cent that of the Waldorf-Astoria, which has a private branch exchange operating 1500 extension stations. The first section of this huge installation, consisting of 3000 lines within the building and 1200 lines to the central office, has been completed and will be ready for use when the tenants move into the building on May 1.

From the main exchange of the New York Telephone Company, at 15 Dey Street, the cables run into a vault in Cortlandt Street, and thence through a subway into a terminal room situated at the southeast corner of the concourse floor in the building. In the terminal room is the central frame, the center of the whole system and where the 3000 pairs of conductors in the house cables converge. The two buildings are 22 stories high and together have floor space of about 1,000,000 square feet. In the Fulton Building the arrangement allows one pair of conductors for every 310 square feet and one pair of conductors for every 300 square feet in the Cortlandt Street Building.

A certain number of the circuits, about 1200 in all, will go directly to various offices from the central office of the telephone company. There are three main cables in the Cortlandt Street building with 600 pairs of conductors each and two in the Fulton Street building with 600 pairs of conductors each. A tenant who occupies more than one floor, as in the case of the American Bridge Company, will have a special private line cable from their switchboard direct to the floors which they occupy. The main cable from the central office to the floors is continuous and has no wires exposed. All wires, in fact, are concealed in shafts, conduits and in moldings from the point where they enter the building to each instrument. In the installation about 5,000,000 ft. of No. 22 wire is used which, if connected in one line, would reach from New York to St. Louis, about 1000 miles.

About 10,000 lb. of copper is required for the wiring, not including the bridle wiring from the terminus to each instrument; the entire weight of the wire used, including the coverings, is estimated at 100,000 lb. When the entire system is completed it will be possible for every one of the 3000 instruments to be used at the same time. On the first section of

1200 it is fair to estimate about 10,000 outside calls a day. Tenants moving from other places of business into the Terminal Buildings require that the changes in their telephone connections shall be made without interruption of business, and 60 men working day and night are at work making the changes. The number of lines in the building is about one-third of the average number of lines ever put into one exchange district in New York City, 10,000 lines being the maximum.

Extensions to New York Public Service Commissioners' Powers.

A bill now before the New York State Legislature makes a number of important amendments to the former act creating the Public Service Commission for the regulation of electric and gas corporations. A clause extending the powers of the commission over telephone and telegraph companies has been removed from the present bill and will form a separate measure.

The bill gives to the commission additional power of supervision over all property owned, leased, operated or controlled by any such gas corporation or electric corporation, and delegates power to order improvements in the maintenance and operation of works, wires, poles, lines, conduits, ducts and other devices, apparatus and property of gas corporations and electrical corporations; to prescribe methods of regulation of the electric supply system, (a) as to voltage regulation of all constant-potential systems, (b) as to current regulation of all constant-current systems, and (c) as to initial efficiency of all carbon filament incandescent lamps, when furnished and renewed free and supplied for use on constant-potential systems, the service for which is charged by meter. It may also, in its discretion, prescribe, by order, the form of accounts, records and memoranda to be kept by such persons, corporations or municipalities. Notice of alterations by the commission in the required method or form of keeping such accounts shall be given at least six months before the same shall take effect. Where the commission has prescribed the form of accounts required and memoranda to be kept, it shall be unlawful to keep any other accounts, records or memoranda than those so prescribed relating to said business. Whenever the commission shall be of opinion after a hearing had upon its own motion or complaint that rates are unjustly discriminatory or unduly preferential or that the regulations, practices or methods are improper, unjust, unreasonable, unjustly discriminatory or unduly preferential or in anywise in violation of any provision of law, the commission shall fix by order the proper, just and reasonable maximum rates and charges and shall determine by order the proper, just and reasonable regulations and practices and methods; and whenever the commission shall be of opinion that the plant, system, equipment, devices or appliances are unsuitable, improper, inefficient or inadequate, the commission shall determine by order the suitable plant system, etc.

The commission is given power to compel the production of any accounts, books, etc., and to require the filing with it all schedule of rates and charges, copies of all forms of contracts and agreements relating to such charges. Prices fixed by the commission shall be the maximum price to be charged by such person or corporation for gas and electricity for a period to be fixed by the commission, not exceeding three years, and thereafter until the commission shall, upon its own motion or upon complaint of any corporation or person interested, fix a higher or lower maximum price of electricity to be thereafter charged.

Exhibit of Safety Devices.

The yearly exhibit of the Museum of Safety Devices, McGraw Building, New York City, was opened on April 11, and will be in full running order by the end of this week. It contains a number of new and interesting appliances, as well as large, typical exhibits by the Pennsylvania Railroad, Carnegie Steel Company and Travelers' Insurance Company. There are several exhibits of an electrical character, and the whole is well worthy of visit and study. The public is invited, and there is no charge for admission. Dr. W. H. Tolman, the director, is in charge. Prof. F. R. Hutton is the chairman of the exhibit committee and Mr. Charles Kirchhoff is chairman of the committee of directors.

CURRENT NEWS AND NOTES.

NEW JERSEY PUBLIC SERVICE COMMISSION.—The New Jersey State Legislature adjourned without passing a public utilities bill, which measure had the support of Governor Fort.

THREATENED TELEGRAPHERS' STRIKE.—The Commercial Telegraphers' Union will, it is reported, order a strike against the Western Union Company unless that company restores wages by June 1. It is said that the Postal Telegraph Company will not be affected, as it did not pursue the course of the Western Union in reducing wages after the strike of last year.

THE ELECTRICAL TRADES SOCIETY, of New York, is making a vigorous effort to extend its membership. The corresponding Chicago society is in the lead with respect to membership, the claim being made that it exceeds in membership the combined lists of the affiliated societies in Boston, New York, Philadelphia, San Francisco and Montreal. Mr. Franz Neilson, 80 Wall Street, is secretary of the New York Society.

MEETING OF PITTSFIELD A. I. E. E. BRANCH.—The tenth meeting of the Pittsfield section for the present season was held April 10, at Hotel Wendell, and about 70 members were present to listen to a paper presented by Mr. W. S. Moody, chief engineer of the Transformer Department of the General Electric Company, entitled "Feeder Regulators." Previous to the meeting the usual dinner was held for the speaker and the members. The section will hold one more meeting this season, the latter part of April.

PITTSBURG A. I. E. E. BRANCH.—At the April meeting of the Pittsburg A. I. E. E. Branch, several papers were read, as follows: Mr. James Farrington, electrical superintendent of the La Belle Iron Works, on the relative advantages of various methods of operating reversing mill tables; Mr. W. A. Dick, on the application of motors to rolling-mill work, and Mr. B. Wiley, on the same subject. The papers of the evening were discussed by Messrs. W. Edgar Reed, C. T. Henderson, Friedlander and James.

AMERICAN VS. ENGLISH BOYS.—Sir William H. Preece, in a paper before the Society of Arts, of London, on "Technical Education in America" said that it is difficult, if not impossible, to make comparison of the methods of technical education in England and America, conditions being totally different. The American boy, he said, possesses the energy and smartness of a new race, the European boy being mentally two years behind him. This, he said, would account for the difference observed in curricula and in papers set for examinations. Canon Jephson, who was, with Sir William, a member of the Mosely Commission which several years ago visited this country to study our educational methods, takes exception to this comparison. The Canon says that owing to the American system of co-education and the preponderance of women teachers, the American boy is retarded in many ways where the English boy is pushed ahead. The English lad, particularly the Londoner, has, he believes, far more shrewdness and common sense than the American boy.

ILLUMINATING ENGINEERING SOCIETY.—Dr. Clayton H. Sharp, past-president of the society, delivered an illustrated lecture on "New Types of Lamps" before the New York Section on April 9. The subject was discussed by Messrs. Doane, Hammer, Williams, Jones, Elliott, and by Dr. Hyde and Dr. Sharp.

NEW ENGLAND SECTION OF I. E. S.—For the meeting this week of the New England Section of the Illuminating Engineering Society, an admirable means to bring out a discussion of value has been adopted. In advance of the meeting a blue print was sent out giving the plan to scale of a shoe store and solutions asked for the problem presented in securing the most effective illumination for the specific case.

THE KELVIN.—At a technical conference of the faculty and student officers of United States Army Signal School, at Fort Leavenworth, Kan., held March 25, a resolution was adopted in the name of the school favoring the adoption of the word *Kelvin* to designate the commercial unit of electrical energy at present known as the *kilowatt-hour*, as a recognition of the services of the late Lord Kelvin in the advancement of electrical science.

DELAWARE RIVER WATER POWER.—At a meeting in New York City last week of representatives of the states of Pennsylvania, New York and New Jersey, the matter of the control of the waters of the Delaware River was discussed, mainly to avoid flood damages. A plan was stated to be under consideration so to control its waters as to utilize them for power purposes and joint action for this purpose by Pennsylvania, New Jersey and New York was discussed.

TORPEDO WIRELESS CONTROL.—A London dispatch announces still another in addition to the many systems which have been proposed for the wireless control for torpedoes. In this case the inventor is Grendell Matthews, who says that by his system a torpedo can be controlled absolutely up to a distance of 7¼ miles, and can be exploded either by concussion or by means of wireless. The same inventor asserts that he has discovered "An electrical wave which cannot be interfered with."

ELECTRIC SHOW STOCKHOLDERS' MEETING.—The stockholders of the Electrical Show, Incorporated, held a meeting on March 6. The old board of directors were re-elected and are as follows: Messrs. Dudley Farrand, Arthur Williams, George F. Parker, Walter Neumuller, W. W. Freeman, James R. Strong and James C. Young. Mr. George F. Parker was re-elected vice-president of the company. The management reports that contracts for space have been received in such numbers as to guarantee the success of the show and warrants the assertion that the exhibition will be the largest and most truly representative of any ever held in New York.

HIGH-TENSION LINES IN NEW YORK STATE.—A bill has been introduced in the New York State Legislature which calls for the installation of a properly grounded "catch-net" under every line of 20,000 volts or over, crossing public streets, highways, railway tracks, canals or which passes over other aerial wires. It is specified that the net should be at least 8 ft. below the high-tension circuit, shall not be less than 20 ft. wide nor less than 22 ft. from the ground, nor less than 4 ft. from any other wire. Furthermore, it shall be supported by poles, towers or other structures erected outside of the limits of the public street, highway, etc., for the full width of the crossing and at least 6 ft. beyond on each side, and of sufficient width and so constructed as to assure the retention of any transmission lines that may fall upon it.

RUMFORD MEDAL AWARDED TO DR. ACHESON.—Dr. Edward G. Acheson, of Niagara Falls, was the guest of the American Academy of Arts and Sciences at the Algonquin Club, Boston, on April 8, the occasion being the award to him of the Rumford Medal. The address of introduction was given by Prof. Charles R. Cross, chairman of the Rumford committee. He spoke of the twin trusts reposed by Count Rumford in the Royal Society and the American Academy, whereby awards are given for important discoveries in light or heat. He noted that the present award was one distinctly in the line of the useful arts, and stated that "interesting as was the work of Moissan in the fabrication of artificial diamonds the work of Acheson far transcends it, for it is a contribution to the direct progress of man." The medals were presented by Prof. John Trowbridge, vice-president. In reply Dr. Acheson referred to his youthful desire to receive one of the medals and gave an account of his researches with the electric furnace. The meeting was arranged at the Algonquin Club through the courtesy of Prof. Elihu Thomson.

STORAGE BATTERY ELECTROLYTE IN COURT.—A somewhat spectacular demonstration was made during trial in New York City of a damage suit brought against the New York Transportation Company by a boy whose lawyer claimed had been knocked down and had rolled in the puddle of electrolyte fluid which had formed after the breaking of the batteries of an electric cab in a collision. He claimed, further, that the electrolyte had burned the boy so severely on the head and face that the burns had not healed for six months. As soon as this allegation was made, both Mr. Wing, counsel for the company, and Mr. William H. Palmer, jumped to their feet and volunteered to wash their hands in the same kind of acid which the plaintiff's lawyer claimed had burned the boy. The boy's lawyer dared them to carry out the proposed demonstration, and they accepted his challenge. With the consent of the judge, a battery of the same type used on the electric vehicle which had been in the collision was then brought in the courtroom, and the acid emptied from it into a basin. Mr. Wing and Mr. Palmer then washed their hands in the electrolyte fluid and rubbed a generous quantity of it on their faces. Mr. Wing, to prove further the harmlessness of the fluid, actually swallowed some of it. The jury was apparently so well satisfied with this demonstration of the inability of electrolyte to inflict the injuries which the plaintiff's lawyer claimed that it brought in a verdict for the company after being out only 15 minutes.

ELECTRIC TRAINS ON THE NEW HAVEN RAILROAD.—The New York, New Haven & Hartford Railroad announces that at present there are 83 trains operated by electricity on week days between New York and Stamford, and 33 on Sundays. By July 1 additional electric locomotives will be in commission and then all trains between the two points will be run by electricity. The power house at Coscob is now working to its full contract capacity, but a fourth unit is to be added to furnish power in case of emergency in the operation of the service. All the repeated and complicated difficulties encountered in installing the electric service, the company says, have been overcome. Electrically-operated trains have been running on the New York Central lines since last July and are considered successful from the operating, engineering and financial standpoints. With the electric system it is possible to use the "air-rights" of the corporation; that is, to build office buildings over the terminal yards. The New York Central property at the Grand Central terminus is worth $50,000,000 more now that the road is to be operated throughout by electricity, taking into account this possibility of erecting revenue-producing buildings on it. Money is also saved in the lighting of yards and terminals, since with the present facilities it is easy to provide current for other purposes, and in this way the road will save $200,000 a year. The power house is designed to take care of peak loads, and electric power will be used in the operation of bridges, unloading machinery, etc. Switching will be done largely by electricity and by the use of electrical automatic stops, the presence of more than one man at the front of the train is unnecessary.

Generating and Distributing System of the Portland (Ore.) Railway, Light & Power Company.—II.

STATION B.

THIS generating station, located at the falls of the Willamette River opposite Oregon City and distant approximately 13 miles from Portland, is the second water-power plant of the Portland Railway, Light & Power Company as regards size.

The power station is of concrete construction and consists of a series of pier walls, vertical and horizontal arches, connected and reinforced by the use of iron rods built in the concrete, arranged to form separate chambers or independent sections, below the generator room floor for the draft tubes, flume and water wheel rooms. The flume or wheel rooms are connected by arched openings through the dividing pier walls. The first set of arches above the foundations forms the floors for flume and wheel rooms and the second set of like arches forms the roof over the flume and wheel rooms and the floor of the generator room. The generator room is 246 ft. long; for 206 ft. the room is 38 ft. wide and for the remaining 40 ft. the room is 64 ft. wide; the walls are 17 in. thick, of concrete, and 20 ft. high from floor to roof truss plate and are strengthened with pilasters every 16 ft. The room is well lighted and ventilated by 26 windows.

The elevation of the flume or wheel floor is 21 ft. above the low-water surface of the tail race and 57 ft. above the lowest part of the foundation. The generator room floor is 56 ft. above the low-water surface in tail race and 6½ ft. above the highest known water level in the river below the falls. The roof is of timber-truss, plank-sheathed construction, covered with composition-felt and gravel roofing.

The station is equipped with a 12-ton electric traveling crane and two 12-ton manually-operated traveling cranes. The electric crane can be used throughout the entire length of the building except in the end offsets which are served by the manually-operated cranes. The switchboards and electric controlling apparatus are located in the central portion of the building. The racks to prevent débris getting to the wheels are set at an inclination of 1½ in. per foot to facilitate cleaning, and are supported by a steel frame of I-beams and channel-beams, securely tied together and built into the concrete walls of the station. The forebay is open and extends in front of and up to the concrete wall of the station.

The tail race is a natural arm of the river into the edge of which the station has been built. The penstocks are of wrought steel having cast-iron heads and covers, and are connected to the open forebay by short, steel, cylindrical feed pipes extending through the concrete wall of the power station; each unit being independent and equipped with a supply gate operated by hand power through gearing. The supply gate is provided with large balanced iron wickets, so that it may be closed and the water shut off from the penstock without difficulty even though the wheel gates could not be closed nor the wheels shut down through accident to their gate gearing or from other cause.

The original overflow dam was a timber crib, plank deck, rock filled structure, fitted and secured to bed rock with iron anchor bolts and had an upstream slope of 2 horizontal to 1 vertical and downstream slope of 1 horizontal to 1 vertical, the slopes converging to an apex formed of heavy timber, rounded off. The height of dam varied from 3 to 20 ft. and the base was 30 ft. at the widest part.

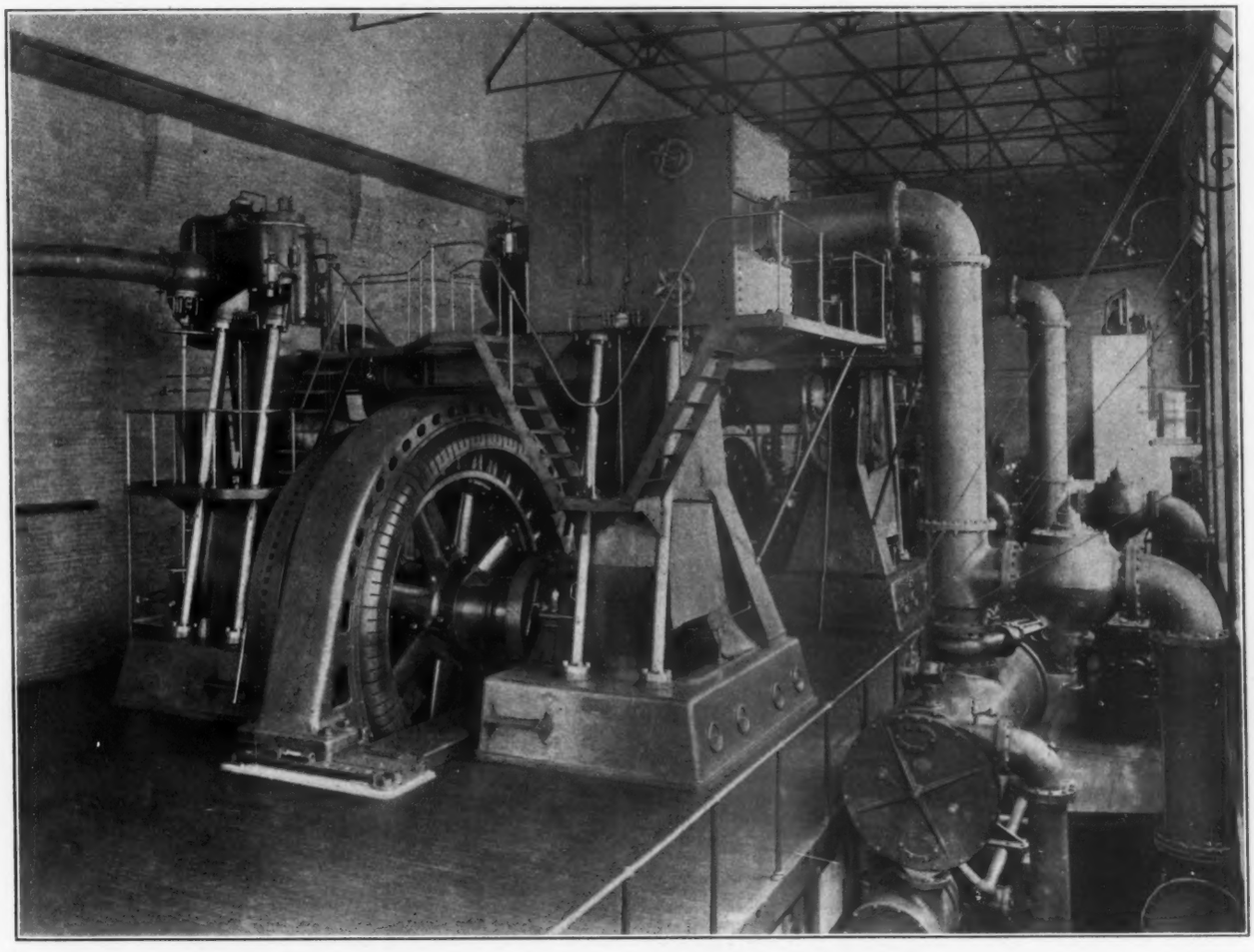


FIG. 1.—PARTIAL INTERIOR VIEW OF STATION E AT PORTLAND, ORE.

This original dam structure on the west side of the river and extending to the center of the falls, was replaced in 1904 by a solid concrete dam, made necessary by new works constructed at the falls, and it is proposed to replace the balance

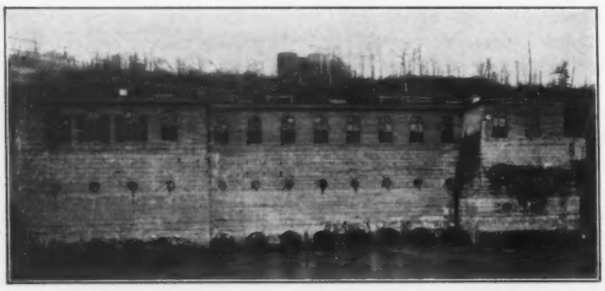


FIG. 2.—REAR OF STATION B, OREGON CITY, ORE.

of the timber crib dam with a tight concrete dam, thereby shutting off all leakage and waste of water during the low-water period. The present length of the overflow dam is 2460 ft.

The storage area directly above and in front of the wheels, considering the open forebay only, is 27,500 sq. ft., and it has a depth of 20 ft. at low water. The water supply of the Willamette River above the falls is furnished and maintained by the watershed immediately tributary to it and numerous streams the most important of which are the McKenzie, Calapooia, Santiam, Pudding, Molalla, Long Tom, Mary's, Luckiamute, La Creole, Yamhill and Tualatin Rivers, with their numerous forks and smaller branches, having their sources in the Calapooia Mountains at the extreme headwaters of the Willamette itself and in the Cascade and Coast Range Mountains respectively; the whole system draining an area estimated at, approximately, 10,030 square miles.

The maximum flow of the river occurs during the wet season from December to March inclusive, and approximates an average of 350,000 cu. ft. per second. The average flow for a number of years past has approximated 66,500 cu. ft. per second and the minimum flow of the river is about 7000 cu. ft. per second.

The physical conditions are very exacting, as the hydraulic installation has to work under a maximum head of 40 to 42 ft. and a minimum head of only 20 ft. There are ten 42-in. Victor, vertical-shaft turbines, each direct-connected to a generator on the wheel shaft in the room above; and ten 60-in. vertical-shaft turbines. One of each of these sizes of turbine is placed in the same section or compartment as the 42-in. wheels. The smaller wheel is so placed as to utilize the higher head during the low-water stage, and the large wheel is placed back of the other one, it being designed for use during high water or low head. Its power is transmitted to the shaft of the smaller one by belting; there being a 46-in. double-leather belt whose tension is regulated by a belt-tightener. Both turbines have draft tubes, and it is customary to run both at ordinary stages of the river. During times of high water in the lower river when the head obtainable does not exceed about 30 ft., only the 60-in. wheel is operated. During the lowest stages when the supply is insufficient, only the 42-in. wheel is used, as it is more efficient.

The wheels have a vertical height of 21 ft. above the surface of the tailrace during low water. Both the wheels are arranged so as to drive the generator at the fixed speed of 200 r.p.m. at all heads from 20 to 40 ft. There are also two separate 48-in. Victor turbines each of which is fitted with a direct-current generator, used as exciters, and two pairs of 51-in. McCormick horizontal-shaft turbines, each driving a three-phase generator at a speed of 143 r.p.m. All the turbines have cylinder gates, and all of the vertical wheels except the 60-in. turbines are provided with ring and oil-pressure piston thrust bearings. The 60-in. wheels have only ring thrust bearings. The piston bearings are placed in cases supported on cast-iron columns and they are arranged to carry the weight of the revolving part of the generator and of the pulleys and shafts. No part of these weights comes on the water-wheel steps, as each shaft is in two parts connected just above the wheel by a pin drive or a jaw coupling.

FIG. 3.—VIEW OF INTERIOR OF STATION B AT OREGON CITY, ORE.

FIG. 4.—VIEW OF WILLAMETTE FALLS.

The following generators extend in a row down the room at this station:

Seven 450-kw three-phase 10,000 volt revolving-armature, 33-cycle vertical generators; three 500-kw, three-phase 10,000-volt revolving-field, 33-cycle, vertical generators; two 540-kw, three-phase, 10,000-volt revolving-field, 33-cycle, horizontal alternating-current generators; two 200-kw, vertical, 125-volt direct-connected generators, used as exciters and operated by the two 48-in. wheels set in vertical shafts, in one section. All generators were supplied by the General Electric Company.

The switchboard is made up of marble slabs, one for each of the generators and exciters. Energy is transmitted by means of cambric-insulated cables to hand-operated oil switches, located at the rear of the generator panels in concrete compartments; the operating handle for each switch being located on its respective panel. After leaving this switch the electricity passes through disconnecting switches directly to the 10,000-volt busses. These busses are located above and at the rear of the switchboard panels on a gallery provided for the purpose. The generator field rheostats are also located on this gallery.

In addition to the usual instruments, each generator panel is provided with a governor control switch, and bus sectionalizing switches are provided for separating the bus into two sections for convenience of operation. All the 10,000-volt generators are connected in parallel on the busses. A system of signals used by the attendant on the generator floor enables him to keep in touch with the water-wheel tender on the floor below. Leading from the busses are three 10,000-volt, three-phase feeder lines running to Portland; two on a pole line down the west side of the river and one on a pole line down the east side of the river. In addition to these feeders, a 10,000-volt feeder crosses the canal to the transformer substation located on the bluff overlooking the river, where by means of seven 750-kw oil, water-cooled transformers, manufactured by the General Electric Company, the voltage is stepped up to 33,000 and the electrical energy sent to Salem, a distance of about 40 miles, feeding the substations of the Oregon Electric Railway Company on the way.

In addition to the above there are located in this station a 500-kw frequency-changer set, two 400-kw rotary converters, six single-phase, 150-kw, air-blast transformers, suitable alternating and direct-current operating panels, and one blower set for supplying air to the transformers.

Oregon City is supplied with 60-cycle alternating current for lamps and motors. A Tirrill regulator is used to maintain a constant voltage on the generator. A 50-light mercury arc rectifier-set is provided for feeding the arc lamps in Oregon City and surrounding territory.

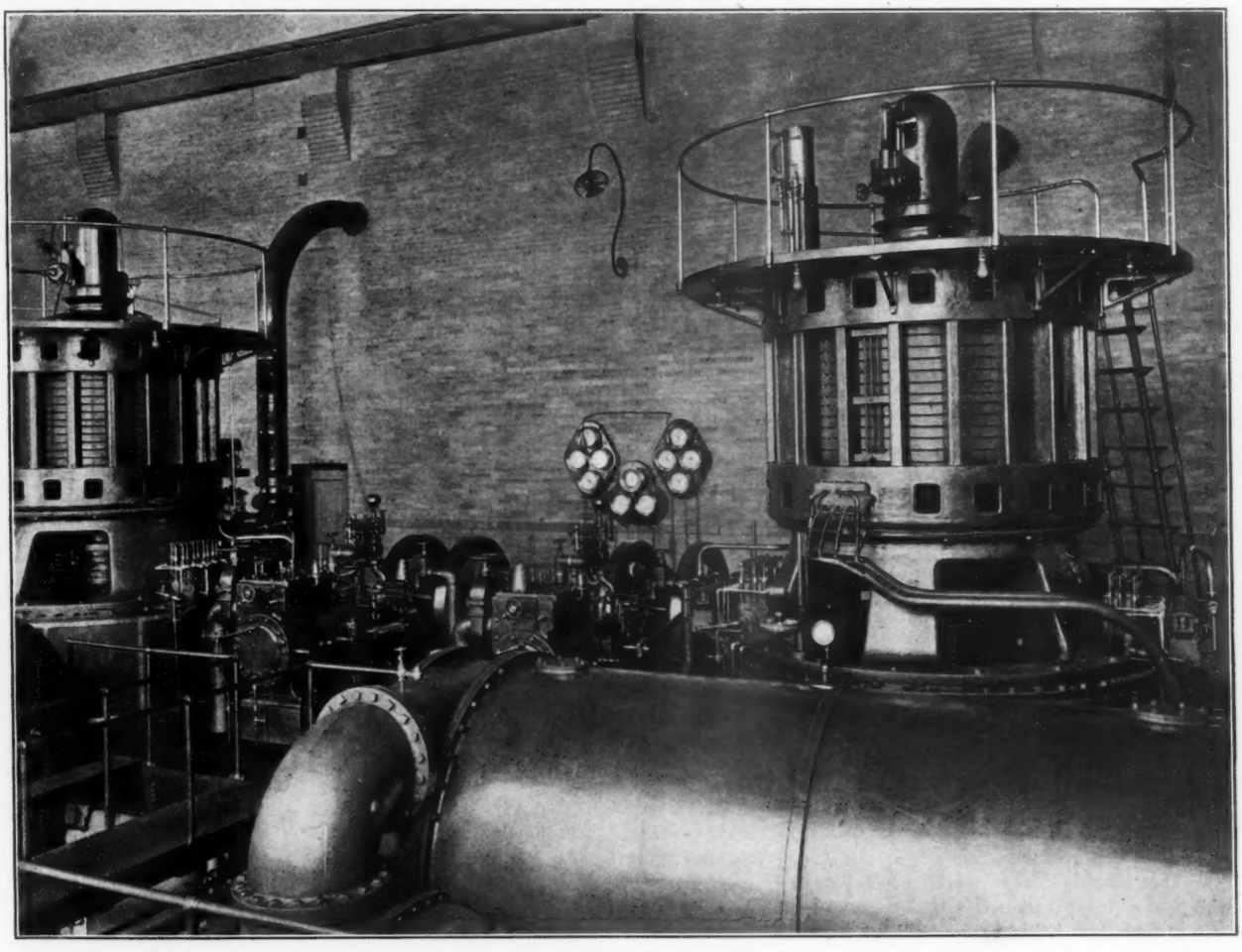


FIG. 5.—INTERIOR VIEW OF STATION E, PORTLAND, ORE., SHOWING TURBO-GENERATORS.

STEAM GENERATING PLANTS.

There are three steam generating stations operated in the city of Portland in connection with the Lower Willamette Valley System of the Portland Railway Light & Power Company; stations C and E, located in the northern part of the city near two large saw mills, and station F, located at the Inman-Poulsen Lumber Company's plant in East Portland.

Stations C and E are adjacent to each other on a piece of property situated at the intersection of Nicolai and Front Streets, with a detached strip 40 ft. wide extending out to the harbor line of the Willamette River.

Station C is made up of a boiler room 100 x 40 ft. and an engine room 100 x 120 ft., all being included in a frame structure covered with galvanized iron siding with wooden truss roof and tar and gravel covering. The engine room and boiler

room are separated from one another by a 12-in. curtain wall of brick.

The fuel used in this station is sawdust and cut fuel, the latter being the product obtained by passing refuse at the mill through a "hog" which chops it up into a fine condition so that it can be handled by means of a conveyor. This fuel is brought from the mills by means of an industrial railway, which the company has constructed, and deposited in the top of a stock house; the railroad running up to this on an incline and the cars dumped directly into the stock bins. A system of conveyors which consists of hard wood floats fastened to a log chain and all driven over suitable sprockets by means of a small steam engine or electric motor, conveys this material from the stock house into the boiler room and thence into an opening in the top of the extended portion of the boiler furnace known as a Dutch oven. The boiler room equipment of this station comprises fourteen 100-hp. horizontal tubular boilers, and four 125-hp. horizontal tubular boilers. These operate at 100 lb. pressure.

The engine and generating equipment of this station is as follows: one 1600-hp double Wheelock non-condensing engine connected by means of rope drive to an 800-kw railway generator; one 1000-hp Allis cross-compound condensing engine connected by rope drive to a 750-kw, 10,000-volt, 33-cycle alternator; and one Fulton compound, marine-type engine direct-connected to a 200-kw railway generator. The 750-kw

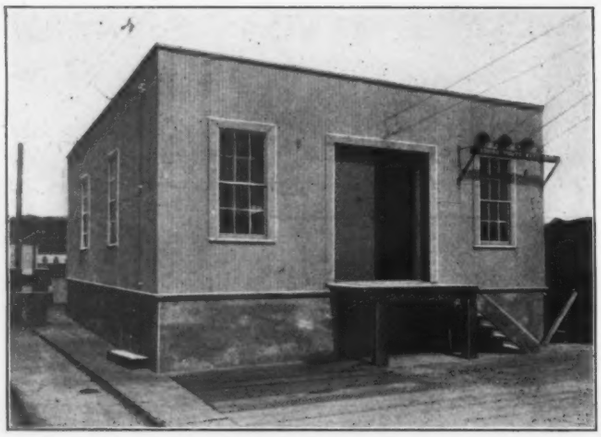


FIG. 6.—EXTERIOR OF PUMP HOUSE OF STATION E.

alternator delivers electrical energy to the operating busses located in station E and also to the 10,000-volt feeder system connected in parallel with the alternators in station E.

Station E is a handsome, one-story, brick structure surmounted by a flat steel-truss roof with steel purlins. The roof sheathing is made up of matched boards and covered with a tar and gravel roofing. The boilers are located in a very commodious boiler room provided with concrete floor and surmounted by a large ventilator. The feed-water pipe is located in suitable p'ts in the floor, these pits being covered with cast-iron plates. A reinforced-concrete stack 230 ft. high and 12 ft. in diameter stands immediately outside the boiler room and provides ample draft for the five batteries of Cahall water-tube boilers which form the boiler-room equipment.

These boilers are rated at 520 horse-power each with two to a battery, and are operated at 175 lb. pressure. Three of the batteries are equipped with Foster superheaters built to superheat the steam to 175 deg. Fahr. One end of the boiler room has been reserved for a commodious pump pit in which are installed Blake outside-packed, plunger feed-pumps; the suction of these pumps can be taken either from the discharge of the circulating water as it comes from the condenser or directly from the river. Arrangements are also so provided in case either of these two sources of supply fail, that water can be forced into the boilers from the city mains.

The Goubert feed-water heaters are provided for heating the water previous to its introduction into the boilers. The high-pressure steam piping, which was furnished by the M. W. Kellogg Company, is made extra heavy of lap-welded, mild, open-hearth steel with Vanstone joints. All the low-pressure piping, except the free-exhaust from the feed-water heaters, is of standard-weight, wrought-iron pipe, the free exhausts above mentioned being spiral-riveted, sheet-iron pipe.

The boilers in station C, like those in station E, are provided with Dutch ovens for burning sawdust and cut fuel. There

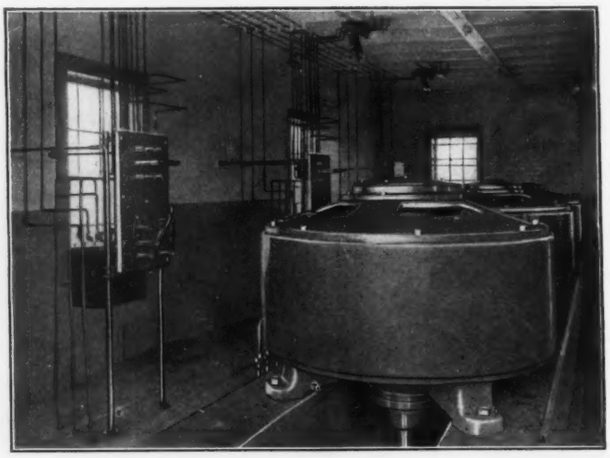


FIG. 7.—INTERIOR OF PUMP HOUSE, STATION E.

are two of these ovens for each boiler or four for a battery. The ovens are also equipped for oil burning, two Morrissey oil burners being used in connection with each oven. The steam and oil piping is so arranged that by means of unions the burners can be quickly and easily disconnected when it is desired to change from one fuel to the other. Underground storage tanks of sufficient capacity to hold eight car loads of oil are located on the company's property just outside the station. A duplicate oil pump system has been installed.

The generating equipment of station E consists of two 1400-hp marine-type, vertical compound engines built by the Willa-

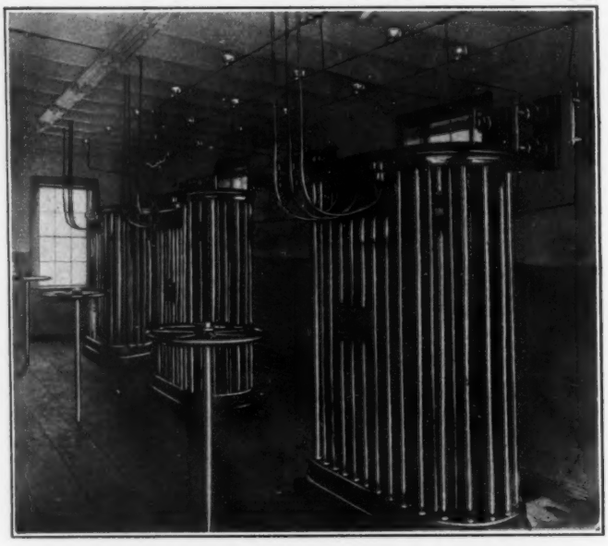


FIG. 8.—TRANSFORMERS IN PUMP HOUSE, STATION E.

mette Iron & Steel Works of Portland, connected to two 1000-kw, 33-cycle, three-phase, General Electric alternators; one Ideal engine exciter set of 85-kw capacity; one motor-generator exciter of 60-kw capacity; and two Curtis steam turbines rated at 1500 kilowatts, but good for 2000 kilowatts continuously. The condensing system of station E consists of two Worthington surface condensers each having 2300 sq. ft. of cooling surface, and two Worthington surface

condensers each having 7800 sq. ft. of cooling surface, the latter being used with the Curtis turbines. These condensers are provided with air coolers and hot wells and with the necessary dry-vacuum and hot-well pumps. The turbines are also provided with two outside-packed, plunger pumps for forcing the water into the step bearings at a pressure of 450 lb. per square inch. An accumulator is used in connection with these pumps.

A gravity oil system is used in connection with the engine and turbines; small pumps located in the condenser pits force the oil to tanks near the roof. The White Star oil filters are used in connection with this system.

The switchboard in station E is composed of General Electric apparatus; busbars, oil-switch mechanism, lightning arresters, potential transformers, etc., all being placed in concrete compartments and controlled by panels placed at a suitable distance in front of these compartments. Remote control is used for all high-tension switches. The lightning arresters, field rheostats, potential transformers and watt-hour meters are located in a basement, the panels being on the main operating floor. Two tiers of oil switches are used, the one being on the operating floor and the other located in a gallery immediately above. The generators are connected to the switchboards by means of cambric-insulated, three-phase cables drawn into ducts under the floor.

For supplying water to the circulating system a pump house has recently been installed at the harbor line at the end of

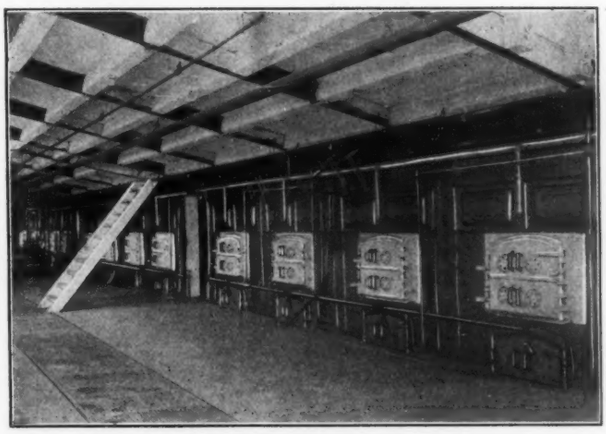


FIG. 9.—DUTCH OVENS, STATION E.

the 40-ft. strip owned by the company. In this pump house are located three 16-in. vertical, centrifugal pumps manufactured by the Platt Iron Works, and direct-connected to three General Electric, 200-hp induction motors. The water thus obtained is discharged into a 33-in. sheet-steel riveted pipe which conveys the water a distance of approximately 1000 ft. directly into the condenser pit in station E. After passing through the condenser the return water leaves by means of another 33-in. main and discharges again into the Willamette River at a distance of about 600 ft. from the point of intake.

The motors driving these pumps are supplied with energy from the busses on the station E switchboard at 10,000 volts, the potential being stepped down at the pump house by means of three-phase oil-cooled transformers.

Station F, which is located at the Inman-Poulsen Lumber Company's plant at East Portland, is a one-story brick structure divided into two portions by a heavy brick curtain wall. The boiler room is provided with 13 return-tubular boilers having an aggregate horse-power of 2060. The station equipment consists of one 625-kw engine-driven railway generator and two 325-kw railway generators with suitable switchboard panels to control the same.

A 1000-kw, six-phase, 600-volt direct-current rotary converter, with the necessary transformers, blowers, switches, etc., has recently been installed at this substation and the steam apparatus shut down, but arranged to be held as a relay in case of need.

Sawdust and cut fuel are used at this plant, a stock house being provided as at stations C and E. The nearby mill furnishes this fuel. In the event of a lack of sawdust and cut fuel, provision is made so that slabs of wood may be burned in the Dutch ovens.

THE UPPER WILLAMETTE VALLEY SYSTEM.

The steam plant at Salem is the main generating station of the Upper Willamette Valley system. This plant generates 60-cycle current at 2300 volts and direct current at 550 volts. The generating equipment of this station is as follows: one 250-kw, 2300-volt, 60-cycle Westinghouse generator; one motor-generator set consisting of a 400-kw, 60-cycle, 2300-volt General Electric alternator direct-connected to a 600-volt direct-current generator, and one motor-generator set consisting of a 200-kw, 2300-volt, 60-cycle motor, direct-connected to a 150-kw, 600-volt generator. These sets are used as double-current generators. In addition there are one 400-kw vertical engine set for 500-volt railway service, and two constant-current arc transformers, suitable panels, instruments, etc., for controlling this apparatus.

A 1000-kw, six-phase, 600-volt, direct-current rotary-converter, together with the necessary transformers, blowers and switchboards, etc., has recently been installed in the substation building adjacent to the steam-power house where the energy transmitted from Station B, Oregon City, is transformed and used for the local street-railway system and through motor-generators sets for lighting purposes. The steam plant has been shut down and is now used for relay purposes only.

VANCOUVER SYSTEM.

The Vancouver system is provided with one generating station situated in the city of Vancouver. The generating system is two-phase, 2300-volt, 60-cycle, and the equipment consists of one 330-kw inductor-type alternator; one 75-kw inductor-type alternator, and one 400-kw, General Electric alternator. A constant-current transformer is provided for supplying the city arc lighting system.

The boiler equipment is made up of six water-tube boilers. In this plant, as in the plants in Portland, cut wood and sawdust is the main fuel used. When there is not sufficient supply of this on hand either slab or cord wood is fired into the boilers.

The station at Vancouver is a frame structure covered with a composite roofing. The company contemplates erecting a substation at this point in the near future at which time the generating plant will be shut down and held in reserve.

Design of Electromagnetic Brakes.

By J. Nikonow.

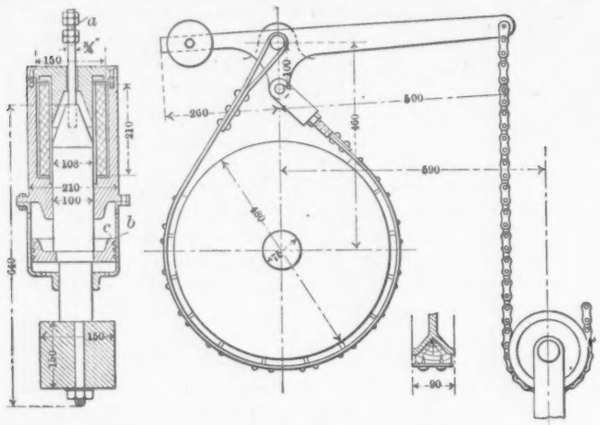
WHETHER a given design of an electromagnet is actually the best for a certain application is a matter of some difficulty to determine owing to the absence of standards of comparison such as exist for other classes of electrical machinery. The criterion of efficiency is usually inapplicable to magnets, owing to many other considerations rendering efficiency of minor importance. Electromagnets, designed to operate brakes, are in the nature of small auxiliary apparatus, consuming a relatively trifling amount of energy, but involving several special points of prime importance which must be considered in connection with the design of the brake itself. Among these points are the following:

1. Will the magnet do the work required under the worst operating conditions? 2. How quick and reliable will be its action? 3. Size and weight. 4. Cheapness in construction. 5. Adaptability to the machine of which it forms part (crane, hoist, etc.).

It must be borne in mind that each of these magnets must allow a definite travel for its plunger, and the designer's task is to make this travel as short as possible in order to decrease the m. m. f. of the magnet coil and, therefore, its size and cost.

Sometimes a little change in the design of the magnet or the brake may lead to quite an appreciable improvement in these respects, as will be shown later.

Fig. 1 represents a very common type of plunger magnet. It is designed to operate two powerful brakes of a 30-ton hoist, built by the Allgemeine Electricitaets Gesellschaft in Berlin. The plunger carries on the top of the rod *a* a wheel 8 in. in diameter, with a chain connected to the arms of the two brakes,

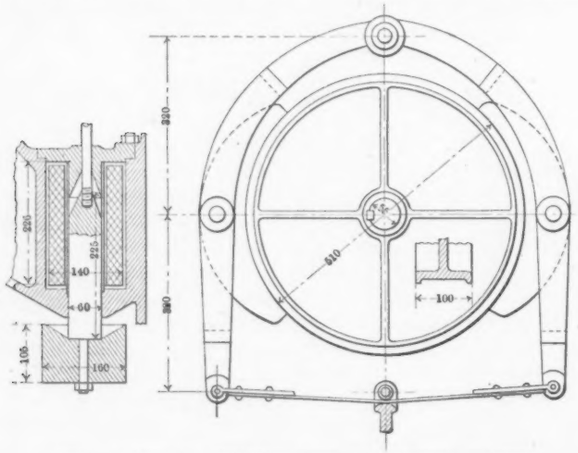


FIGS. 1 AND 2.—COMMON TYPE OF PLUNGER MAGNET.

as may be seen in Fig. 2. The weight of the plunger tightens the brakes until released by the current in the coil. Because of the considerable weight of the plunger, an air chamber *b* is added with a piston *c*, which acts to dampen the movements of the plunger. Two side brackets (not shown) are used to attach the magnet to the frame of the hoist. The wooden shoes fitting the channel in the brake wheel proved to be an excellent braking device. Two brakes were used in this case, as the hoist had four motors with series-parallel control, in order to give three efficient speeds for the rope, namely, 10, 20 and 40 ft. per minute.

Such a magnet operates at about 6500 ampere-turns and requires 10 amperes on a 110-volt line. It is connected in series with a non-inductive resistor to decrease its time-constant and in multiple with another resistor which takes the inductive discharge when the circuit of the coil is opened quickly. Two inches of travel is sufficient to release the brakes completely.

This type may be called an automatic brake with negative



FIGS. 3 AND 4.—COMMON TYPE OF PLUNGER MAGNET.

action, the braking being produced by the weight of the plunger, so that the hoist can work only when current exists in the magnet coil and the plunger is raised. This arrangement insures automatic braking of the hoist when power is off or when the electric circuit is defective. It has, however, the disadvantage that the total pull must be exerted when the plunger is in its lowest position and, therefore, when the air-gap is longest and the magnetic flux is at a minimum. Such a magnet should be designed to have the full working flux coincident with the longest air-gap. In certain cases it is possible, however, to use electromagnets with positive action, and therefore non-automatic, the weight of the plunger releasing the brake and the magnetic pull tightening it. In that case the necessary pull is produced at the end of the travel when the air-gap is the smallest, so that the magnet will have comparatively small dimensions for the work required.

An electromagnet will develop the same pull no matter how many turns of wire are put on its coil, provided the number of ampere-turns is constant. It appears, therefore, that in every case it is advisable to have as many turns as possible and to use the smallest possible current. In practice, however, following this rule leads to some difficulties, as may be illustrated by a practical example.

A positive brake was built in connection with a 150-hp motor. The magnet had the same dimensions as that of Fig. 1, but the coil contained 7020 turns of No. 16 wire, having about 165 ohms of resistance; thus about .65 ampere existed in the coil when subjected to 110 volts.

The magnet proved to be strong enough to operate the brake, but it worked extremely slowly owing to its high inductance, an

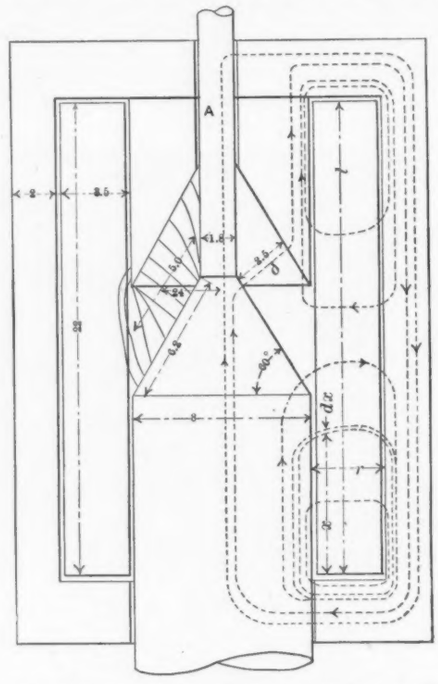


FIG. 5.—LEAKAGE PATHS AROUND A CONICAL PLUNGER.

interval of several seconds occurring after closing the circuit before the plunger began to move. As this was not satisfactory the coil was rewound for about 6 amperes with some external non-inductive resistance; the brake then worked properly and did not require any dash pot to dampen its movements. Of course, in the second case, the efficiency of the magnet was only about one-tenth of what it was before, since it required 10 times as much power to operate.

To make the matter of efficiency clear, consider the condition of a magnet from the moment when the circuit is closed. It is necessary to expend some energy to overcome the inductance and to bring the magnetization of the system to its final condition. This energy is stored in the form of a potential energy and while the magnet remains in circuit it possesses this amount of stored energy independent of how many watts in the coil are being converted completely into heat. If the circuit is opened this stored energy is released in the form of kinetic energy, in the mechanical movement of the plunger, or in heating the coil. The presence of the moving plunger changes the form of the kinetic energy, because it changes the condition of the inductance of the magnet.

A mathematical analysis will show that by decreasing the

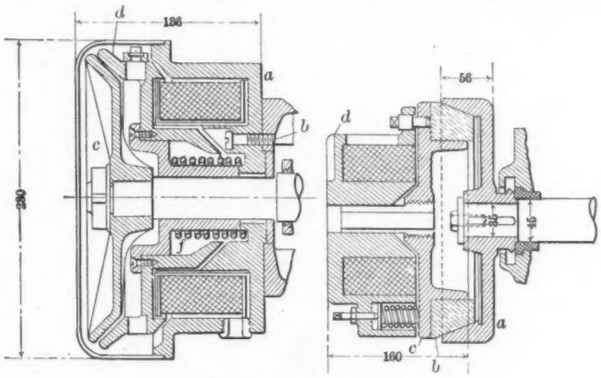
current the inductance is increased, and that by decreasing the inductance the current is increased for the same work. Unfortunately, use cannot be made of a simple formula for the determination of the inductance of ordinary magnets containing iron, because the magnetic permeability is constantly changing with the change of current.

Fig. 3 shows a similar magnet, built in the foot of the motor bracket of a 10-ton hoist. Here the plunger is hung by means of a rod on a steel strap connecting two cast-iron brake shoes surrounding the brake wheel, as is shown in Fig. 4. When the coil is energized, the plunger releases the brake shoes. (In Figs. 3 and 4, and also in Figs. 1 and 2, the dimensions indicated are in millimeters.)

All these magnets have a conically divergent air-gap with sides inclined at 60 deg. to the axis of the plunger. Theoretically, in such a case the total pull is four times as strong as for the same travel with a flat air-gap. Practically this is true when the air-gap is comparatively short.

That the pull will be four times as strong will be appreciated when it is remembered that the pull varies directly with the product of the square of the magnetic density and the area of the plunger. When the angle is 60 deg. the area is increased by 100 per cent and the effective air-gap is decreased by 50 per cent so that the magnetic density is doubled. Thus the pull perpendicular to the air-gap is increased to eight times its former value, and that component in line with the travel is changed to four times its former value.

For a very large air-gap conditions are somewhat different. Fig. 5 shows diagrammatically the air-gap of a magnet having



FIGS. 6 AND 7.—BRAKE MAGNETS.

a plunger 80 mm in diameter and a coil 35 mm thick (with the insulation) and 220 mm long, surrounded with a yoke 20 mm thick. The total weight of the plunger is 9.828 kg, and it is raised 50 mm when the coil has a m.m.f. of 5460 ampere-turns. The rod in the middle is probably saturated magnetically, and the direction of the magnetic lines may be represented as shown on the left side of Fig. 5. These lines are considerably elongated on the outside and inside extremities of the gap, so that in these places the magnetic density is reduced. The decrease in density may be taken into account by assuming a smaller cross-section for the gap. The reduced width of the gap, as shown on the drawing, is 5 cm. Therefore the area is 75.4 cm and the magnetic density as computed for the weight of plunger and area of gap is 2560, which requires a m. m. f. of 5120 ampere-turns. This value of m. m. f. must be increased, as the iron of the magnet has some reluctance and requires also a certain number of ampere turns. The total flux in the gap is 193,000 lines, and the density in the yoke is therefore 1810 lines per square centimeter.

Leakage, however large it may be, does not change directly the condition of the useful flux, but it increases the density in the yoke, and also the inductance by increasing the total amount of flux in the magnet. By increasing the yoke density, the total reluctance is somewhat increased, so that the leakage affects the useful flux indirectly. This influence, however, may be very different, depending upon the saturation of this yoke, so that in one case the leakage may be 100 per cent, and in another 25 per cent, and yet in the latter case a larger value of m. m. f. may be required.

To find the magnetic induction in the yoke it is necessary to find the leakage flux. One part of this may easily be found, namely, the flux in the rod *A*. This rod is of soft steel and is magnetized up to saturation, having a density probably of about 18,000 lines per sq. cm. Multiplying by the area, 5.65 sq. cm, the total flux in the rod is 102,000 lines. This flux must be added to the useful flux to obtain the actual density in the

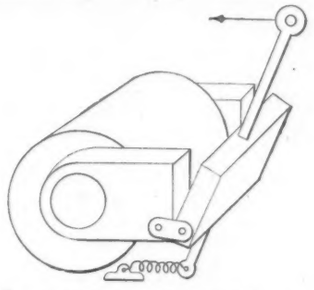


FIG. 8.—ARRANGEMENT OF SMALL MAGNET.

yoke. Apparently it is advisable to make it smaller by decreasing the diameter of the rod, for instance, or by using a rod of hard steel.

As the coil is very closely surrounded by iron, the leakage flux must be very large. At the ends of the coil magnetic lines encircle a smaller number of ampere-turns, but at the middle of the coil the number of the ampere-turns is increased, and therefore the flux is also increased. With a uniform thickness of coil the flux will increase in direct proportion with the distance x. The smallest induction will be obtained with the location of the air-gap right in the middle of the coil, as represented in Fig. 5. In that case the total leakage flux is divided into two equal halves. A mathematical calculation shows that the leakage flux in air is 130,000 lines. Hence the total flux produced by the magnetizing coil must be $193{,}000 + 102{,}000 + 130{,}000 = 425{,}000$ lines. The magnetic density being 3960 lines per square centimeter, the required m.m.f. is 196 ampere-turns for the cast-iron yoke. The plunger, which is made of wrought-iron, requires about 30 ampere-turns. The top part of the frame, which is made of cast-iron, requires 180 ampere-turns. Hence the total m. m. f. required is $5120 + 196 + 30 + 180 = 5526$ ampere-turns. Experimentally it was found necessary to use

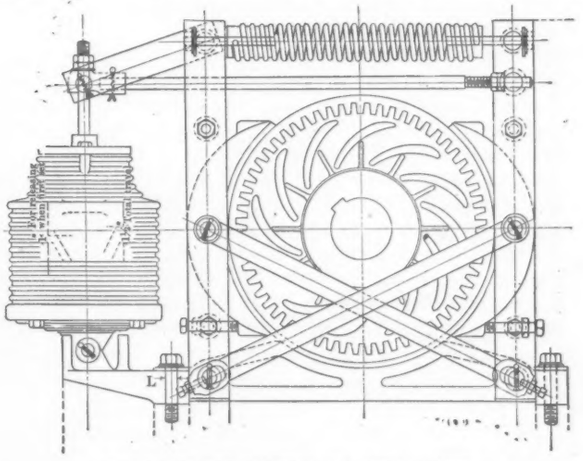


FIG. 9.—BRAKE MAGNET FOR MILL MOTOR.

5460 ampere-turns, so that the above calculations give a value very closely approaching the experimental result.

The problem may arise as to how to estimate the mean length of the working air-gap. With a short air-gap the full length may be taken, but when the air-gap is comparatively long it is better to take a length shorter by from 10 to 20 per cent. The best way, of course, will be to divide the air-gap into different parts, according to the possible directions of the lines of force, and determine the magnetic density and the length of the lines

for each particular section, and then take their sum. With the direction of the lines as shown in Fig. 5, the result will be almost the same as with the mean length of the gap section assumed above. The air-gap between the plunger and the magnet is very small and it can be neglected in comparison with the working air-gap.

It is interesting to calculate the performance of the same magnet built with a flat air-gap. The leakage flux will be the same as before, so that working (calculated) number of ampere-turns will be again 5120. The useful magnetic density will be 1365 lines per square centimeter. The area of the gap being 44.35 sq. cm, the tractive force will be 3.35 kg. This value is only one-third of what it was before.

Suppose the magnet shown in Fig. 5 has a travel of only 2 cm and is subjected to a m. m. f. of 5950 ampere-turns, what will be its performance?

It is impossible to solve such a problem exactly, but after two or three approximations it is found that the magnetic density in the gap will be about 4370, which gives the total useful flux of 417,000 lines. The air-gap is comparatively short now, so that its full area of 95.5 sq. cm may be taken. Leakage flux in the rod, which will be almost unchanged, may

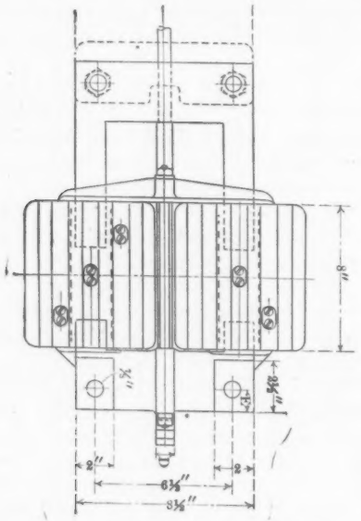


FIG. 10.—SMALL PLUNGER MAGNET.

be taken as 102,000 lines, and the coil leakage will be increased in proportion with the increase of the ampere-turns, to 142,000 lines. This leakage will actually increase more than in proportion to the increase in m.m.f. on account of the somewhat increased leakage area, but the error of assuming exact proportionality is comparatively small.

The total flux in the yoke will be 661,000 lines, and the magnetic density 6180 lines per square centimeter, requiring a m.m.f. of 730 ampere-turns for the yoke. The magnetic density in the core being 12,600, the m.m.f. will be 1590 ampere-turns. The plunger being subjected to a magnetic density of 13,200, the m.m.f. must be 105 ampere-turns. The useful m.m.f. will be $5950 - (730 + 1590 + 105) = 3535$, or approximately 3500 ampere-turns, which gives the useful magnetic density of 4370, and a tractive force of 36.3 kg. By test the tractive force was found to be 37.2 kg.

Fig. 6 is a magnet with a brake built in connection with a Siemens-Schuckert hoist (½ ton, 60 ft. per minute speed of the rope). Magnet frame *a* with the coil is attached to the end of the bearing by means of the screws *b*. Dish-like bronze friction plate *c* is firmly attached to the end of the motor shaft. The plunger *d* is made from soft steel and is always pressed against the bronze plate by action of the spring *f*. After the coil is energized, it pulls back the plunger *d* against the spring and releases the motor shaft. A cover renders the equipment dustproof.

The great advantage of this construction is that the travel is very small (from 1/16 to 1/8 in.) so that the magnet is very small in size for the work required; it is rapid in action and is perfectly reliable.

A similar construction is shown in Fig. 7. This is a brake for a high-speed ½-ton hoist built by the Actiengesellschaft Volta. Here a steel friction plate *a* rubs against the fiber ring *b*, attached to the plunger *c*. Three springs hold the plunger against the plate *a*. The magnet *d* is screwed to the frame by means of two side brackets (not shown).

Fig. 8 represents a very good arrangement for a small magnet. Experience shows that with such an arrangement for the same length of travel, the magnet develops considerably larger pull than with the ordinary parallel motion of the armature.

Fig. 9 represents a Westinghouse electromagnetic brake for mill motors. Here the braking is produced by the spring, and

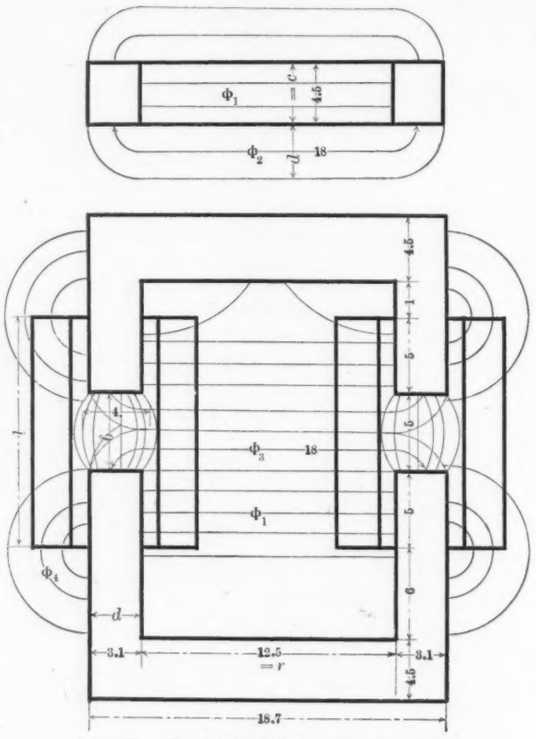


FIG. 11.—MAGNET WITH FLAT SURFACES.

the magnet releases it. The pulling force is considerably less than the tension of the spring, due to a very ingenious arrangement of the levers.

ALTERNATING-CURRENT MAGNETS.

With alternating current it is necessary to use a laminated core, so that all such magnets have a very simple form, such as shown in Fig. 10, which represents a Westinghouse magnet for a 3-in. travel for lifting 150 lb. The design of such magnets is somewhat more complicated than is the case with direct-current apparatus. For example, suppose that it is desired to design a magnet for a 5-cm (or about 2-in.) travel and a lifting force of 18 kg to operate on a 440-volt, 25-cycle line. After some trials the reactive electromotive force is found to be 410 volts. Moreover, by trials it is found that a convenient number of turns for two coils would be 2350. From transformer relations it is found that at a frequency of 25 cycles a coil of 2350 turns at 410 volts would require 156,500 lines. Assuming a maximum density in the iron of 12,000 lines per sq. cm and noting that 8 per cent of the section of the core is occupied by the insulation between laminations, the cross-section is found to be 14 sq. cm.

Fig. 11 represents such a magnet with a cross-section of the iron of $3.1 \times 4.5 = 14$ sq. cm. Due to a very long air-gap and considerable density in the iron, lines of force spread out in the gap, as shown, so that the mean area of the gap must be taken as about 22.9 sq. cm. It would be a serious mistake to assume the area of the gap equal to that of the iron. The flux in the gap is considerably less than in the iron, due to a very large

magnetic leakage with magnets of such a form. We have now all data necessary to calculate the useful flux in the gap. The magnetic density will be:

$$B=\sqrt{\frac{P\times 8\pi\, 981000}{A\times 2}}$$

Where P is the pull in kg A = area of the gap. Substituting numerical values,

$$B=\sqrt{\frac{18\times 8\pi\, 981000}{22.9\times 2}}=3120$$

And the total flux is

$$\phi=3120\times 22.9=71{,}500 \text{ lines.}$$

The required number of ampere turns is

$$IN=\frac{2B\delta}{.4\pi\sqrt{2}}$$

Where δ is the length of the gap. In that case the gap is twice as long as the travel, an extremely unfavorable condition as compared with direct-current magnets, where it is possible to make the gap shorter than the travel.

Substituting numerical values,

$$IN=\frac{3120\times 2\times 5}{.4\pi\sqrt{2}}=17600$$

Adding about 300 ampere-turns for iron, the total amount of m. m. f. is 17,900 ampere-turns.

By actual test it was found that the magnet took 7.65 amperes, or 18,000 ampere-turns, and the magnetic density was 3180, and the total useful flux 72,900 lines.

The difference between the total and the useful fluxes repre-

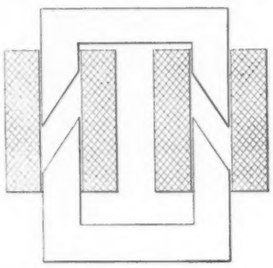


FIG. 12.—MAGNET WITH INCLINED SURFACES.

sents the leakage flux of 156,500 — 72,900 = 83,600 lines. Hence the leakage flux amounts to about 115 per cent of the useful flux.

In order to make the leakage as small as possible the following methods may be employed:

1. The air-gap must be somewhere inside of the coil, preferably in the middle.
2. The coils must be as far as possible apart.
3. Dimension *d* must be longer than *c*.
4. Dimension *l*, Fig. 10, must be as short as possible.
5. The form in Fig. 10 possesses larger leakage than that in Fig. 5. It has also another disadvantage in that the air-gap is twice as long as the travel. It might be helped, however, to some extent, by using the form shown in Fig. 12, which undoubtedly will give better results than that in Fig. 9.

The power factor of an alternating-current magnet is always very low, even with the longest travel. On account of its reactance it should not be connected in series with the motors, as it is very often done with direct-current magnets for series-wound motors.

Another interesting feature of an alternating-current magnet is that the flux and pull remain almost unchanged with all positions of the plunger from the beginning to the end of the travel, because the flux depends only upon the voltage, number of turns and cycles (frequency); the length of the gap affects only the current, which decreases in proportion with the decrease of the gap, until a large degree of saturation in the core is reached. The magnet described above draws only about .55 ampere at the end of the travel, or about one-fourteenth of the value at the beginning.

For operation at 220 volts the coils of the magnet must be connected in parallel, and then it would develop the same flux and pull, taking about 16.3 amperes. For 110 volts it is necessary to use four coils in parallel, the current then being 32.6 amperes.

When the same magnet is used at 60 cycles, instead of 25 cycles, it will operate with about the same current as before, provided the e. m. f. is increased to 2.4 times its former value.

College Training of Electrical Engineers.

BY PROF. ARTHUR C. SCOTT.

Lord Kelvin said that the first object of an education is "to enable a man to live," and the second, "to assist other men to live." The truthfulness of this statement is nowhere more apparent than when considered with respect to the engineer of the present time; to him is due, more than to any other, the great improvements in communication, transportation, illumination and sanitation, which so manifestly assist other men to live. Moreover, it must be admitted that the phenomenal advance made in electrical engineering within the past few years has brought comforts and luxuries to the public at large never before considered possible.

It has been well said that "the recent rapid development of the electrical industry owes its vitality to the engineering school. Its graduates have done the designing, constructing, operating and directing which have made possible the rapid progress and wise extension in the use of electricity."

Granting that this is true, the questions of vital interest and importance at present are:

Does the average university or college technical school properly prepare its students for their life work as engineers?

Does the sequence of courses taught, and do the methods of teaching afford the maximum opportunity for the student, when viewed from a common meeting point of the psychological and pedagogical standards within the college, and the practical or operating standards outside it?

Such questions as these, or something akin to them, have of late been the source of voluminous, and no doubt profitable discussion, although a digest of papers recently published in the American Institute transactions, the ELECTRICAL WORLD, and the proceedings of the Society for Promotion of Engineering Education, appears to show that no common ground of agreement has yet been reached.

A few years ago the manufacturers and heads of corporations gave the college graduate but little encouragement because they did not appreciate the value of concentrated theory; the probable reason why to-day they are saying, "Give us technically educated men," and are filling vacancies in their factories and systems with college men, is on the one hand that the college is constantly endeavoring to improve methods of instruction, including such practical testing and laboratory work as will be more in line with their requirements, and on the other, the manufacturer or corporation manager is becoming educated to recognize the importance of sound theoretical training.

The most potent criticism by large manufacturers and property managers of their college graduate employees, at the present time, appears to be that they lack a certain kind of human common sense, and that they do not know how to adapt themselves to new conditions, or to adjust their personalities to the wishes of their superiors; that they lack most decidedly the ability to direct men and are loath to assume responsibility which requires originality or initiative on their part.

To meet such deficiencies several of the large concerns have established special apprenticeship courses, and it has recently been shown that with one large company, of those who finished the apprenticeship course, 50 per cent are now with the company, and the others are with operating or electrical supply companies, or acting as consulting engineers or instructors.

The apprenticeship course attests the validity of the criticism, but there are grades of adverse criticism, and it appears that the sort presented is the best, for the following reason: A

student passes from three or four years of cramming, memorizing effort in the high school to the college. During the first two years of his college course he is likely to go on memorizing as in the high school, and does not really learn how to study or concentrate his mind on the work before him until some time during the junior year, or possibly the senior year. As a matter of fact, it appears that there is not sufficient time for him to obtain a knowledge of the fundamental principles underlying a broad education in engineering, and at the same time carry on work involving much originality, or the direction of men. Therefore, the criticism of the manufacturers in general of college graduates is what one familiar with professional college work might expect. There appears to be no doubt, however, in the minds of all that fundamental principles of mathematics, mechanics, physics, chemistry, English, foreign languages and political science are a necessary part of the engineering graduate's proper training, as well as the more specialized subjects of engineering.

One writer representing a large manufacturing company says: "Engineering students usually hate rhetoricals and language courses. They should remember that engineers are sometimes called upon to fill positions which are worth more than $75 per month, and that in such positions they will need to know how to speak and write the English language."

In attempting then to answer the question as to whether the average university or college technical school properly prepares its students for their life work as engineers, a noteworthy distinction should be made between the technical courses of the colleges and the technical courses of the trades schools. While the latter may take the student as far in the strictly technical subjects of engineering as do the college courses, these schools do not assume to spend any time upon the so-called culture studies that are required in college courses in engineering. If the culture studies were removed from the college courses, there would be more time available for the student to develop originality in his work and possibly to obtain some instruction concerning the direction of men, and commercial accounting.

Under these conditions, however, he is likely to become narrow-minded concerning his work; he gains nothing socially which a knowledge of the culture studies may accord him; he is limited to a direct line of work because he has insufficient training to give him the confidence in himself to start in any other. His earning capacity "in the long run" is decreased proportionally, as has been well shown by statistics collected some time ago by James M. Dodge.

It appears that it is unwise for the university technical school to attempt to go much farther toward the manufacturers in attempting to turn out students who shall just suit them at the start. In the first place it is impossible to graduate men who would suit the requirements of all the manufacturers or employers. Methods are different in different places, and require time and attention spent on them by anyone, whether student or not, before he is in a position to show much originality or power of direction.

It stands to reason that the *general aim* of the courses of the average technical college at the present time is commendable; namely, the thorough training of the student in all subjects fundamental to engineering, with the introduction of such culture subjects as will serve to place the student on an even footing, intellectually and socially, with men in other professions, and in so far as this result is accomplished the college directs its student in the proper way. In other words, the graduates have the rudiments of their profession, and the essentials of cultured citizens; personal characteristics, environment and time are depended upon for final results.

The time is at hand, however, when the engineer should be so educated as to appreciate the artistic possibilities in his product, and to exhibit esthetic sense in design. When the great engneering feats of to-day become the ordinary products of to-morrow, the public will demand beauty of design, as well as rigidity and utility of construction and installation. And when the demand is made the men who have finished an A. B. course in the university, followed by a full engineering course, will occupy first positions because of the important cultural training which they possess.

I am thoroughly of the opinion, therefore, that the average technical college does not *properly* prepare students for their future work as electrical engineers. The chief reason is that an attempt is made to complete subjects in a four-year course, which, if properly taught, would require fully six years. It is no wonder the student does not develop the spirit of original research—he has no time to do anything but attend lectures in the morning and laboratory practice in the afternoon for six days per week, and even at that pace does not properly cover the ground. The electrical engineer must be more of an all-round engineer than any other; he must not only have the fundamental knowledge of theoretical and applied electricity, but in addition must be reasonably familiar with much of civil, steam, hydraulic and gas engineering.

Moreover, he should have some general instruction concerning the public service corporation methods of the division of labor, accounting and general policy toward the public; on the law of contract; and on the interpretation of specifications and plans concerning both buildings and equipment.

Many of the universities are recognizing the fact that the engineers are doing from one-third to one-half more work during the four years taken to graduate than are the academic students. This, of course, is largely due to the relatively great number of hours spent in the laboratory, and commendable changes are already being made in several technical colleges, substituting a five or six year course for the four-year course heretofore required.

With the ever-increasing additions to the present great store of technical knowledge, I have no hesitancy in expressing my belief that the institutions that are in the lead with a five or six year technical course will readily find better positions for their graduates than will the others. It certainly appears reasonable that in an institution having well-equipped laboratories and a corps of competent instructors, it is possible for the student during the one or two extra years to do much more for himself than would be possible in the same time after leaving at the end of a four-year course with what amounts to a too hastily swallowed dose of everything taken; this is evidenced not infrequently by cases of acute mental indigestion and, as complained of by the manufacturers, an utter lack of originality, judgment, or logic in meeting shop requirements.

The longer course gives the student time for some attention to athletics, social functions, perusal of current engineering literature, a better training in culture subjects and a much more thorough training in theoretical and applied engineering, than a four-year course. My view of the situation, considering the best interests of the students, is that any college offering technical courses leading to an electrical engineering degree, should require the equivalent of a five-year course to obtain the B.Sc. degree in electrical engineering, with the further provision that the E.E. degree be allowed for an additional year of study involving a thesis covering original research work; maintaining the standard entrance requirements as at present and the same for all students.

I venture to presume that the two additional years thus covered by the student in the university would be of more benefit to him eventually than the first five years following the completion of a four-year course if spent elsewhere.

The answer to the first question involves to some extent the answer to the second. It is evident, if the presumption be granted that four years is too short a time for the college man to complete an electrical engineering course, that the methods of teaching might be improved. It does not necessarily follow, however, that an increase of time required would involve a change in sequence of subjects.

Professor Karapetoff in his paper on "The Concentric Method of Teaching Electrical Engineering" outlines a four-year college course which in some respects quite reverses the customary sequence of subjects as taught in college technical schools.

The advantages claimed for the arrangement are:

1. The student selects his profession after having had an outline course in it, in parallel with a few other allied specialties.

2. The method of beginning with the practical side, in other words, with the ultimate results, is more psychological than beginning with abstract auxiliary sciences.

3. The interest and the professional feelings in the student are early aroused.

4. He can spend his vacations more profitably, having had engineering courses from the start; he can also be interested in technical literature and societies earlier than is possible with the present method.

5. A possibility is created for producing "learned artisans" who have taken one or two of the early years, and may then be useful in practice as assistants, or can do independent work in newly opened parts of the country, etc.

6. The theory, being built on the known facts of experience, will be less abstract, and more in unity with the requirements of practice.

It will be seen from the discussions of his paper that there is a great difference of opinion as to the value of Karapetoff's method, with adverse criticism in general preponderating.

As to the first advantage claimed for the arrangement, I thoroughly agree that the first and possibly the second years should be identical for all engineering students, so that the student may wisely select what he wants after having moved in the university atmosphere long enough to clarify some of his nebulous notions. But it appears that to carry out Karapetoff's plan would necessitate an outline course in several engineering subjects from the practical or manipulative side. If this were given, it appears that the first year would be largely given up to playtime exercises, which would not benefit the student materially because it would tend to weaken his ambition by a complete reversal of the order of advancement in his former secondary school training. It would probably mean that nearly the same per cent of students would fail as with the present plan, with the added expense and inconvenience to the colleges that would result when such failures come in junior and senior years instead of in the freshman year.

Moreover, a large freshman class would necessitate a relatively large amount of apparatus to inspect and manipulate; an increased number of instructors; and above all, a necessary increase of time to do such work in addition to the requirements of the already established four-year course. I do not see how Professor Karapetoff would be able to find the time in a four-year course for this arrangement and maintain even the present adversely criticised standard of completed courses for the engineering degree.

Referring to the second point, it appears decidedly more psychological and pedagogical to begin with the finished product, and reason toward the underlying sciences and general theory, than to consider the subjects in the reverse order. But in attempting to do so in the case of engineering work great care would be necessary to prevent the student from obtaining a distorted idea of the importance of the finished product. Finished products change from year to year as a result of the more accurate application of theory in manufacturing. Beginning with the practical side of a college course in engineering will no doubt tend to stimulate the interest of the student, but what appears to me to be of equal or greater importance, is that he comes in contact with members of the strictly electrical engineering faculty much earlier in his course than would otherwise be the case. Both of these points are worthy of careful consideration, and in order to cover them and also arouse the professional feelings of the student as early as possible, a course in what might be called Electrical Engineering Physics, would serve the purpose. This course should be given during the freshman year by the head of the school or an associate professor, and should not presume to duplicate the subject of general physics, except in so far as electricity is concerned. As a part of the course the use of vectors, the algebra of complex quantities, practical lessons in curve plotting, and practice in interpreting machine drawings might very profitably be taught. The course would involve the study of various machines, controlling devices, lamps and illumination, from the physics standpoint largely, but including such illustrations with the laboratory equipment as would readily give the student an idea of commercial apparatus.

This course should in no way substitute for or interfere with the regular required course in physics, and should not require the duplication of physics apparatus to any considerable extent, because the course should be so given as to make it possible to use such apparatus as should be on hand for electrical engineering course demonstrations in general. As a matter of fact, the pure physics demonstration work should be left entirely with the school of physics, except in so far as engineering apparatus is concerned.

I believe that such a course taught by a professional engineer would give the student a perspective that would serve to hold his interest, and tend thereby to improve his work all along the course. The professor, moreover, would become acquainted with the students early in their course, which is likely to be of mutual benefit.

Aside from this somewhat radical departure from historical methods of teaching electrical engineering, there are two other changes that, to my mind, ought to be made in some of the existing methods of teaching this subject.

The first concerns itself with lectures, recitations, quizzes and examinations; the second with the plan of conducting laboratory work.

Concerning the first, I believe that the student is handicapped when a text book alone is used. No text book on electrical engineering to-day is up to date in all particulars, hence notes should be furnished, or a text book supplemented by notes used. This is, however, of less importance than the method pursued with respect to recitations. I believe that for every two or three hours of lectures to juniors and seniors there should be a conference hour wherein the points of importance concerned with any of the previous lectures may be discussed with a perfect freedom between the members of a class, or of sections of a class, and the instructor. Occasionally the conference hour should be used as a quiz period without previous announcement to the class. This keeps the students alert and up with the subject at all times, and is but a mild prelude to what they will encounter later on as engineers. When the layman wants information from an engineer, he is seldom so thoughtful as to give the engineer a week's notice before asking his question. The engineer must train himself to think quickly, and logically, and independently of any text book.

Problems should be given in abundance to oblige the student to make rigid application of theoretical principles; conferences and quizzes serve to keep him up to date in his work; and final examinations necessitate the correlation of the various parts of the subject covered.

So far as laboratory courses are concerned, I believe it to be possible to meet the criticisms of employers of students to some extent. In some of the engineering laboratories the students have nearly all connections made for them and their chief duty one and all in a test is to read instruments and record their readings. I think that is the limit of poor laboratory instruction. The student regards it as a special dispensation at the time, but if he is required to direct a shop test later on, he will no doubt act as though devoid of "human common sense." He does not know what do do, much less how to direct others. The laboratory course that will most nearly meet the adverse criticism of employers to-day is the one wherein the students are required to make all machine and instrument connections, and also that requires some one of the members of a section to act as director of the test at every period, and be responsible to a reasonable extent for the use of machines and instruments. This arrangement is not intended to relieve the instructor from his duties in the least; on the contrary, it may add something to them, for the student whose turn it may be to direct the test should confer with him beforehand in order to be sure that he understands the test

completely, and also to learn what instruments are available for the test.

It is only by actually directing men that one learns how to do it, and if the students gain some practice in this way in the laboratory, they may be less criticised after entering practical work.

Much has been said and written advocating the teaching of mathematics, physics, chemistry and other fundamental sciences of engineering in college or university technical schools by engineers. With this idea I cannot agree.

I have personally had the opportunity of teaching students physics from the preparatory school on through the completion of their college course in electrical engineering, and while the results were at the time eminently satisfactory to me, I believe that I may have unconsciously emphasized the engineering side too much.

The university graduate is presumed to be broadly educated, and he can only be so in fact by studying under specialists in the respective subjects required in the curriculum. When the graduate enters into practice, and throughout the years of his life, he will find it necessary to adapt himself to the ever-changing conditions; every problem in engineering of any magnitude will present features differing in one respect or another from any that have preceded it, and the solution is accomplished by ability to select the right fact or principle out of the mental storehouse, and apply it with good judgment and perseverance. Why, then, should it be considered necessary to have mathematics, for example, taught in the university by an engineer? The common reply is: "Because an engineer will give the student practical engineering illustrations and engineering problems that the pure mathematician cannot or will not." The answer may be true, but does not the danger lie in the possibility of his giving about all of his illustrations and problems an engineering significance? From the mathematics standpoint the student's mind is narrowed toward engineering. He is presumed to be studying *mathematics, not engineering,* and should be taught *mathematics.* It is *his* business to make the application of mathematics to his engineering work whenever he needs this handy tool for a purpose. I believe the subject, when taught by a man who is first of all a *true professional mathematician,* will serve its purpose in *educating the student in the subject,* regardless of what he intends to be, and regardless of whether the professional mathematician be also an engineer, a linguist, or a college president. The same may be said of physics, chemistry, English, and all other subjects entering into the courses required of students who graduate from the standard college or university.

Each required subject, if taught by a specialist in that subject, should have enough interesting features in the teaching to hold the attention of a student possessing a scientific or engineering mind; if it does not, he is in the wrong line, and the sooner he changes his course the better it will be for him. Physiography, mineralogy, geology and astronomy, while not ordinarily included in the curriculum of the electrical engineering course, are improper subjects and by no means outside the scope or demands made on the electrical engineer's training to-day. A part or all of these subjects might well receive attention in connection with a five or six years' course in electrical engineering to the ultimate profit of the student taking them.

To sum up, then, finally:

(1) The demands of present-day electrical engineering are such as to make the extension of the normal college course of four years to five years highly desirable.

(2) To stimulate the interest of the students in professional engineering early in their college course, and to bring the students into contact with professional electrical engineers, the head of the school or an associate professor should give a course in electrical engineering physics to first-year men.

(3) Conference hours should be held in connection with theoretical work; one conference hour for each two or three hours' lectures to juniors and seniors on engineering subjects.

(4) Laboratory courses in electrical engineering strictly, should require the students to arrange all connections to instruments and machines in the electrical laboratories, or the connecting of all auxiliary apparatus for tests in steam or gas engineering laboratories, together with the direction of the section on each test performed by some one of the section previously designated by the instructor.

Such changes, I believe, would materially assist the engineering students to attain the scholarship rank of students in other university departments and also to more successfully meet the demands of commercial practice.

Letters to the Editors.

Varnished Cloth Insulation.

To the Editors of Electrical World:

Sirs:—I have read with much interest the article on page 379 entitled "Varnished Cloth Insulation" and would like to ask through your columns a few questions of those who so enthusiastically advocate its use.

First: Is the varnish as prepared for use on oiled or varnished cloth a neutral compound?

Second: Under the working conditions of electrical equipment, subjected as it is to various mechanical and chemical changes, do the insulating properties of oiled linen increase or decrease; and if either, why?

Third: Does the fabric in varnished cloth rot or weaken under the working conditions of electrical equipment?

Fourth: Why does one kind of oil or varnish tend to rot the cloth more rapidly than another?

Fifth: Could other than a neutral insulating material be considered permanent, used in the preparation of this cloth?

Boston, Mass. C. B. Tibbetts.

Patents and Inventions.

To the Editors of Electrical World:

Sirs:—Having recently served on the Examining Corps of the United States Patent Office I am much interested in the able articles and strong editorial appearing in your issue of March 14, and criticising this branch of the Interior Department.

If I may be permitted, however, I would like to add a word of discussion in regard to a portion of the editorial. On page 542, near the bottom of the first column, you state that "A patent once granted, it is apt to control the advancement in the art on account of the enormous expense now attendant on patent litigation; and even if litigated, our patent courts, as now constituted, appear to lay inordinate stress on the presumption of invention in cases where others have not previously availed themselves of the idea in suit."

I wonder how many readers know the curious and almost paradoxical condition of affairs that exists in connection with the question of patent litigation? One would naturally suppose that, after the government had made a "grant" to an inventor, and had endowed him with an "exclusive right" by affixing its "great seal" to a solemn instrument, such grant would be respected. One would suppose that an inventor, armed with such a document, would be justified in imagining himself able to hold the field against all comers. One would suppose, *at least,* that there would be a *presumption* in favor of the validity of the patent; that any one denying such validity would be compelled to prove his contention, and that, in the absence of such proof, the patentee could exercise his rights and prevent piratical inroads upon his ideas.

But such is not the case. A patent is absolutely valueless until it has been proven *good* in a court of proper jurisdiction. A manufacturer may infringe with impunity any patent he chooses, and the owner of such patent has no relief and can secure no injunction until the patent has successfully withstood the refining fires of a lawsuit, and all the efforts of its

enemies to cast a cloud upon it have proved vain. In other words, the patent is *presumed* to be *bad* until a court of record has decided that it is *good!*

Queer perversion! And, since a clever attorney may cause a suit to drag along for a protracted period, it is evident that a patent may be infringed for *years* in many cases without the owner having any remedy, and frequently the suits may be continued until the owner's resources are quite exhausted and he gives up the fight in disgust.

It appears, therefore, that "the enormous expense" of patent litigation is apt to be felt more heavily by the owner of the patent—by him whom the government has adjudged to be entitled to protection—than by those who are endeavoring to utilize the inventor's ideas. This state of facts tends to lessen very much the possibility of a patent being "apt to control the advancement in the art," and for this reason may be regarded as beneficial, although undoubtedly imposing a heavy burden on the inventors of the country.

As to the courts laying stress on "the presumption of invention," it is doubtful if as many patents are sustained as should be. The records show that, of all patents, small and large, which get into the courts approximately *one-half* are for one reason or another held to be *invalid and void,* or else not infringed. And in this connection it is to be borne in mind that these litigated cases represent the *cream* of the patents—those of real commercial value.

Washington, D. C. J. Hanson Boyden.

[The remarks to which Mr. Boyden refers were intended to apply more particularly, not to patents that involve the exercise of the inventive faculty and are, therefore, apt to be real factors in the advancement of an art, but to the class of patents, now seemingly becoming preponderant, which merely cover the steps of normal engineering evolution and tend, through the control they exercise over an art, to stop its development along the lines of real invention. As to "holding the field," a worthless patent may effectually close the field to all meritorious inventors who cannot command means to establish its invalidity; the fight of the independent inventor is nowadays not to hold a field, but to gain entry to it, or prevent being forced out. The final paragraph of Mr. Boyden's letter seems to have little application to the point to which the detached quotation relates.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-Phase Commutator Motors.—M. Osnos.—An article discussing the effect of the short-circuit currents under the brushes of single-phase commutator motors on the phase displacement of the armature current. The short-circuit currents are due to two causes, first, to the rotation of the armature in the field in the commutation zone, and, second, to the transformer effect of the alternating field. The short-circuit currents of the first kind are called dynamic, and those of the second kind are called static. The author shows that the static short-circuit currents always diminish the phase displacement, while the dynamic short-circuit currents produce either a decrease or an increase of the phase displacement according to the phase of the resulting commutation field. An undercompensated commutation field diminishes the phase displacement in the motor, while an overcompensated commutation field increases.—*Elek. u. Masch.* (Vienna), Feb. 23.

Effect of Wave Form on Transformers.—L. T. Robinson and A. Holz.—Any core loss in a transformer should be stated in terms of the loss occurring on a sine wave and any losses determined on other than sine waves should be corrected to that standard. The exciting current is influenced by wave-form variations, and corrections for this should be applied. In the present installment the authors discuss the effect of wave-form variations on hysteresis loss and on eddy-current loss. The paper is to be continued.—*Gen. Elec. Rev.,* April.

Testing Direct-Current Machines.—S. P. Smith.—A communication describing two methods for testing a single direct-current machine, the object being to investigate in a single dynamo the heating and commutation under full-load conditions when only the losses are supplied by the machine.—Lond. *Elec.,* March 20.—Some critical remarks by W. Lulop on these methods in Lond. *Elec.,* March 27.

Lamps and Lighting.

Metallic-Filament Lamps in Overloaded Systems.—O. F. Brastow.—An article discussing the tantalum lamp as the salvation of overloaded systems. The savings due to the introduction of the tantalum lamp are shown for a special case in which 1000 16-cp carbon lamps constituted a heavy and excessively dangerous overload on both the engine and the generator. While each 16-cp carbon lamp consumed 65 watts, the new 20-cp tantalum lamps consumed only 40 watts, so that besides the gain in illumination a gain in output of 25 kilowatts was obtained.—*Gen. Elec. Rev.,* April.

Leading-In or Supporting Wires for Metallic-Filament Lamps.—A note on a recent patent of the British Thomson-Houston Company (General Electric Company of this country). The end of the supporting conducting wire is fused round the filament by means of an electric arc. The fusing is done below the surface of a liquid, such as water, alcohol or benzine, in which inert or reducing elements are liberated by the action of the arc. The liquid cools the globule of metal quickly, and ensures a good contact with the filament.—Lond. *Elec. Eng'ing,* March 5.

Leading-In Wires.—A note on another British patent of the British Thomson-Houston Company for fusing metallic filaments to the leading-in wires. The welding of the wire to the filament is performed by means of an electric arc, in a protecting jet of some reducing gas, such as hydrogen, surrounded by an envelope of an inert gas, such as carbon dioxide. A special nozzle for the gas jet is described.—Lond. *Elec. Eng'ing,* March 12.

Power.

Swiss Energy Transmission.—An illustrated description of the high-tension transmission line and the transformer substations of the Engelberg-Lucerne 25,000-volt transmission system in Switzerland. Along the edge of the Lake of Lucerne the steel lattice poles are supported on brackets extending out from the shore over the surface of the lake, this unusual method of construction having been necessary in order to keep the high-tension wires away from the telegraph and telephone wires previously strung along the edge of the lake. Three substations, for the double purpose of providing a local supply and of dividing up the line into sections, are situated between Obermatt and Lucerne.—Lond. *Elec. Eng'ing,* March 12.

Electric Driving in Silk Industry.—A. Kidd.—Since the conditions in silk mills demand constant speed, the induction motor is the best type of machine to be used. The method of driving a group of machines by one motor is used extensively where the machines are run continuously, such as the preparatory machines in silk mills. The motor should work up to its full rating, in which case the highest operating economy is obtained. The author then discusses the advantages of the individual drive. These are chiefly of increased production, which is "conservatively figured at 5 per cent," and the reduction of the maintenance item to a minimum.—*Gen. Elec. Rev.,* April.

Induction Motor for Driving.—P. Ehrlich.—An analytical investigation of the dynamic phenomena which occur when a machine of periodically varying power (pump, compressor, etc.) is driven by a motor, the power of which depends on the

speed (like the three-phase induction motor).—*Elek. u. Masch.*, (Vienna), March 1.

Traction.

Single-Phase Traction.—L. H. Kidder.—An illustrated article on the working of the 6600-volt, single-phase railway between Pittsburg and Butler, which has now been in use for one year. The experiences and conclusions obtained during this period are dealt with, and it is noted that any troubles encountered have been due to defective material and workmanship rather than defective design. The most serious troubles encountered were with the pantographs and the overhead-line construction. —*Elec. Jour.*, March.

Berlin.—An illustrated description of the new substation on the Berlin electric elevated and subway railways. The original power station generates direct current at 780 volts. Further extensions of the line have made the erection of two substations necessary. These converter stations will be supplied with three-phase currents from a new generating station, but for the present one of these substations is fed with three-phase currents from the original direct-current generating station, which for this reason has been equipped with inverted synchronous converters.—Lond. *Elec.*, March 13.

Installations, Systems and Appliances.

Lightning Arresters.—R. P. Jackson.—A continuation of the long illustrated serial on the protection of electric circuits and apparatus from lightning and similar disturbances. The author discusses cable protection, and then treats of the selection of protective apparatus. Since the protection afforded in any case is directly proportional to the difference in resistance to static discharges offered by the lightning arrester from that offered by the apparatus it is intended to shield, preference should be given to devices that have the lowest equivalent spark-gap, which should always be considerably lower than that of the apparatus to be protected. By equivalent spark-gap is meant that definite size of gap which, when placed in multiple with the arrester, just fails to take the discharge. The length of this gap is the measure of the freedom of discharge of an arrester. The most recent designs of lightning arresters possess equivalent gaps about as low as is likely to be obtained by any reliable self-restoring devices. By this is meant devices which do not have to be reset after each discharge. The author then discusses the present practice of lightning arresters for low-tension distribution systems. The multiple-path lightning arrester, which is suitable for either alternating current or direct current for any e.m.f. up to 1000 volts, receives its name from the fact that the static discharge spreads itself over a carborundum block along a number of minute discharge paths. The nominal e.m.f. between the line and the ground is subdivided between so many minute gaps that the e.m.f. across each gap is too small to maintain an arc after a high-voltage discharge has passed. This arrester has a very long

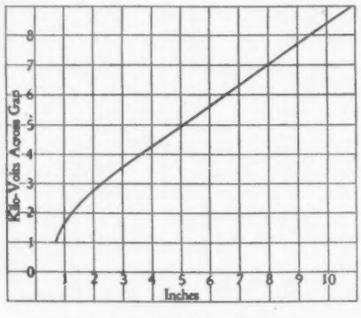


FIG. 1.—VOLTAGE CURVE.

life, say, some 2000 discharges. The author then discusses at some length the electrolytic lightning arrester in which aluminium plates in tray form are set one within another (separated by small insulating washers) so as to form a vertical column, which is enclosed in a stoneware jar. Some details of construction are given, but the nature of the electrolyte is not stated. Electrolytic arresters are made for all e.m.fs. from 4000 volts up to almost any practical value. Both the gap and the electrolytic unit may be installed either indoors or out. While the electrolyte will freeze at about 28 deg. Fahr., it is not permanently damaged by freezing, yet when in frozen condition its conductivity is comparatively low, and the protective power of the arrester is correspondingly decreased. Hence, in order to obtain the best results during the periods of low temperature, the electrolyte should not be allowed to freeze. The electrolytic arrester is used in combination with a horn-gap which will withstand the normal voltage of the system, but will break down with overvoltage and permit the surge of discharge through the electrolytic units. By means of the curve shown in Fig. 1 the proper lengths for horn-gap may be determined. Horn-gaps should not be used on e.m.fs. lower than 13,500 volts, since the gap for lower voltages is so small that the arc will not rise properly and break.—*Elec. Jour.*, March.

Frequency-Changing and Load-Equalizing Plant.—J. S. Peck —A note on a recent British patent for an arrangement for equalizing the load on alternating-current systems, and for supplying low-speed induction motors with low-frequency currents from high-frequency circuits. "The stator winding of the induction motor of a motor-converter set is connected to the supply mains, the rotor winding being connected across to the suitable points on the armature winding of the direct-current generator. This generator has a shunt-field system of the usual type, and the current generated is supplied to a direct-current motor coupled to a flywheel. The working motor is fed with current taken off by means of slip rings connected to the cross-connections between the two rotors of the motor-converter set. The working motor thus normally receives its current directly from the rotor of the induction motor, and in cases of overload, also from the armature of the direct-current machine, which acts as a rotary-converter, taking in current from the fly-wheel motor, which then acts as a generator and converting it to alternating current for driving the working induction motor. When the induction motor is not working, the converter set supplies energy to the fly-wheel motor, which it accelerates."—Lond. *Elec. Eng'ing*, March 12.

Excessive Rate Indicator.—In cases where electrical energy is paid for by a system according to which a certain rate should not be exceeded, it is necessary to let the consumer know when he exceeds the limit. For this purpose use is made of a rocking arrangement which consists essentially of an electromagnet attracting an armature, fixed to a beam and oscillating about an axis, mounted on a fixed support. This beam carries at one end a point which dips into a mercury cup. The current passes through this cup to the beam and coil, and the attraction of the latter is counteracted by a spring. When, however, the current exceeds a certain predetermined amount, the force of the spring is overcome, the beam is attracted and the circuit broken. The beam then flies back and a succession of "makes and breaks" is thus obtained. The oscillatory effect which makes it impossible for the curernt to be used, continues until the excess-consuming devices are cut off. Regulation can be effected by means of a screw.—Lond. *Elec.*, March 6.

London Central Station.—An account of the annual report of the Charing Cross, West End & City Electricity Supply Company, operating both the West End and the City districts, which are practically two independent systems. The combined total cost of energy generation in the combined systems works out at 3.1 per cent per kw-hour including allowance for depreciation.—Lond. *Elec. Eng'ing*, March 5.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—An account of his second lecture on this subject. He first recapitulates his views on the importance of the positive and negative particles disseminated through the air for atmospheric electricity. Water is condensed by preference on the negative particles, which rain or hail then carry down to the earth, thus replenishing the negative charge of the earth. If the particles are produced by the radium in the earth imparting radium emanation to the atmosphere, particularly with a low barometer, then radium plays a very important part in

atmospheric electricity. He then demonstrates various ways by which air may be rendered conductive, as well as a method by which conducting particles of the air can be filtered off. Various agents are capable of splitting the molecules of a gas up into positive and negative ions (which may not be the electrolytic ions), but due to their mutual attraction there is again a tendency to recombine. If two metallic electrodes in air are connected with a battery, the current will send the ions to the electrodes, and the conductivity will thus decrease. As long as the current is small no loss will be noted with increasing e.m.f. But when the potential is further increased, the current carriers in the gas will finally be removed as fast as generated, and the current increase will stop. The current will first follow Ohm's law and then become constant, independent of the potential difference. If a curve of current and potential difference be drawn, the curve will first be a straight line, then become parallel to the abscissa, giving the ordinate of the constant current, and will finally rise and move rapidly, just before the spark passes. The limiting current value, as well as the generation of ions, now depend upon the quantity of gas between the electrodes. If we start with a small gap and double that gap, we double the current intensity; if the gap be increased to threefold, the current will be three times as strong. That is the characteristic paradox of the discharge through gases, which is often misunderstood. We have, of course, to start with a sufficiently high potential to obtain the constant current.—Lond. *Elec.*, March 20.

Magnetization.—O. W. RICHARDSON.—An article suggesting the possibility of a mechanical effect accompanying magnetization. After some theoretical considerations he proposes an experiment in which a long, thin cylindrical bar of iron is suspended by a fiber passing through its axis so that it is capable of vibrating about a vertical axis. It is suggested that the sudden application of a vertical magnetic field might have the effect of twisting the suspended system as a whole. So far the experimental research has not given definite results.—*Phys. Rev.*, March.

"Magnetic Rays."—A. RIGHI.—A note on the discovery of a new kind of radiation which he terms "magnetic rays" and which consists of a projection of molecular magnets from the cathode when immersed in a strong magnetic field. The molecular magnets follow the magnetic lines of force and trace them out visibly. That cathode rays are projected along the magnetic lines of force when the field is very strong was proved as long ago as 1858, by Plücker, and Villard studied this phenomenon in detail two years ago. Now a cathode particle or electron, projected along a magnetic line of force, describes a spiral whose generating circle is smaller the stronger the field. The axis of the spiral coincides with the magnetic lines of force, and when the generating circle is very small the path of the cathode particle cannot be distinguished from the line of force. These magnetic rays do not, however, as a rule, convey a charge. The author concludes that they really consist of binary systems, an electron revolving round a positive atom, with the plane of its orbit normal to the direction of propagation. Such a system would constitute a very flexible molecular solenoid and would have considerable stability. A divergent field would produce a retardation of the system and eventually a return to the cathode.—*Rendiconti dei Lincei*, Feb. 2; Lond. *Elec. Eng'ing*, March 12.

Magnetic Properties of Gases.—B. TÄNZLER.—An account of an experimental investigation. Oxygen is paramagnetic and its volume susceptibility is 0.123×10^{-6} per cubic centimeter, and so is air, with a volume susceptibility of 0.0264×10^{-6}. Both argon and helium are diamagnetic. Argon has a volume susceptibility of -0.00953×10^{-6} and helium -0.00175×10^{-6}.—Lond. *Elec.*, March 20.

Units, Measurements and Instruments.

Capacity of Cables.—F. J. O. HOWE.—The conclusion of his illustrated article on measurements of the capacity of cables. The methods described in the Digest last week had three disadvantages. First, the use of a telephone; second, the unsuitability of the plug resistance box when using a telephone as detector; and third, the necessity of having a high-frequency machine requiring regulation of excitation and adjustment to the resonance state. The second objection is overcome by using a switch arm resistance—in fact, a Wheatstone bridge—the first and third by using an Ayrton and Perry secohmmeter with an ordinary d'Arsonval galvanometer in the place of the high-frequency machine and telephone. The arrangement is shown in Fig. 2. The secohmmeter is driven by a small motor, the speed of which may be varied between wide limits. By

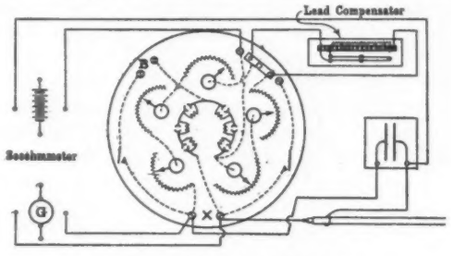


FIG. 2.—SWITCH-ARM RESISTOR.

plugging the Wheatstone bridge ratio arms to 1000 ohms and using a 1.0 microfarad condenser the apparatus becomes direct reading up to 9.9999 microfarads. Tests taken by means of the secohmmeter agree extremely well with the capacity calculated from the charging current. The capacity of the cable equals the value of the condenser multiplied by the ratio of the resistance of dials to the resistance of arms. The author then discusses the method to be adopted. It was desired to keep the order

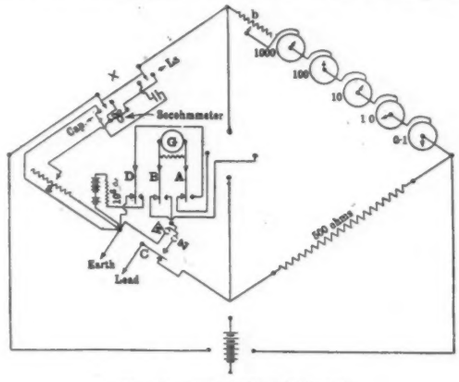


FIG. 3.—CIRCUIT DIAGRAM.

of testing the same as that formerly adopted; that is to say, that the capacity and dielectric resistance tests be taken on one and the same test table, and as near as possible in the same time as that required when testing by the old method. The arrangement adopted, as being the most suitable and at the same time requiring the shortest possible time in carrying out a test, is shown diagrammatically in Fig. 3, and its arrangement on the test table in Fig. 4. It consists of a five-dial switch arm

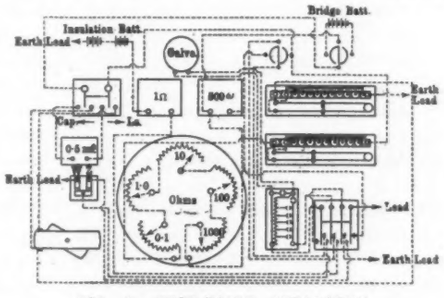


FIG. 4.—TEST-TABLE APPARATUS.

resistance-box with a plug and slide-wire lead compensator *b*, forming the variable resistance arm; a 500-ohm resistance box forming the fixed resistance arm. The third arm consists of the standard condenser of 0.5 microfarad or a variometer; the former for capacity tests, the latter for self-induction tests; the fourth arm consists of the cable to be tested. The galvanometer is provided with a universal shunt with a short-circuit plug.

The battery key is quadruple and has two positions. To make capacity or dielectric resistance tests the secohmmeter is set running and remains running throughout the test. First, the constant of the instrument is determined by putting a plug in *W*, depressing the quadruple key and opening the galvanometer circuit with a suitable shunt. This gives the deflection due to the current through 1 megohm. The key is next released and the plug shifted from *W* to *Z*. The double-pole switch *X* has to be in the "condenser" position. The next point is the test on the leads running from the instrument to the cables to be tested. The resistance dials are switched to zero and the galvanometer opened. The lead compensator is then adjusted until balance is obtained in the bridge circuit. When this balance is obtained and the galvanometer re-short-circuited, the quadruple key is depressed, thus switching on the battery and disconnecting the testing lead from the secohmmeter circuit; the test is now made as usual. When the cable is connected on to the leads, the same routine is followed, excepting that the variable resistance *b* remains unaltered, the balance being obtained by adjustment of the dial resistances. The tests can, therefore, be carried out with more simplicity than by the usual method. The chief idea of this arrangement is that when the quadruple key is depressed, the cable is joined up for insulation testing in the ordinary way. When released the cable is joined up to the capacity bridge, and this bridge is manipulated exactly as the Wheatstone bridge, the capacity being read off directly from the dials. Thus, with the above-described apparatus, the capacity of any cable would be $\frac{0.5}{500} \times$ reading of dials; that is, the first dial represents microfarads, the second tenths of microfarads, etc., and could be engraved in microfarads. To make self-induction tests, the double-pole switch, *X*, is switched over on to the variometer, and the resistance-slide *b*, together with the resistance-dials, set to 500 ohms total, thus making the right-hand arms of the bridge equal in value. The secohmmeter is brought to rest, thus obtaining the ordinary Wheatstone bridge connections. The resistance of the variometer forms the third arm of the bridge, and the resistance of the cable together with the variable resistance *a* form the fourth. Balance is obtained by varying the resistance *a*. Next the secohmmeter is set running, and balance is again obtained by turning the variometer, thus measuring the self-induction directly in the ordinary manner.—Lond. *Elec.*, March 27.

Capacity of Condensers.—B. V. Hill.—An abstract of an Amer. Phys. Soc. paper on the variation of apparent capacity of a condenser with the time of discharge and the variation of capacity with frequency in alternating-current measurements. —*Phys. Rev.*, March.

Alternating-Current Instruments with Iron.—W. E. Sumpner and J. W. Record.—A long paper read before the (Brit.) Inst. Elec. Eng. on several new alternating-current instruments in which iron-cored electric magnets are used. The instruments more particularly dealt with are a wattmeter, a magnetostatic voltmeter and phase meters. Attention is first drawn to the difference between a shunt and series electromagnet. With the former the eddy currents caused in small pieces of brass do not affect the magnetism caused by the exciting voltage. In the instruments of the authors a shunt magnet is used so that it is permissible to use brass clamping-pieces in the neighborhood of the moving system. The field is even more reliable than that of a permanent magnet as used in direct-current instruments. The field of the shunt magnet, though caused by the voltage, is not in time phase with it, so that for the wattmeter a special form of current transformer and for the voltmeter an ordinary condenser are needed, and these accessories are called "quadrature transformers," since their function is to produce a moving-coil current which is in time-quadrature with the circuit e.m.f. on current. The readings of the instrument are independent of the frequency. The form of magnet shown in Fig. 5 has been selected so as to reduce the magnetic reluctance of the circuit to a minimum, on account of its easy mechanical construction, and to allow a large angular deflection of the pointer. The block of iron stampings *A* is securely clamped on a brass framework *L*. The cross-section of iron is about 1 sq. in., the flux is approximately 32,000 c.g.s. lines and its density about 5000 c.g.s. at the normal applied voltage on 50-period circuits. As the section of the gap is five or six times that of the iron core, the flux density in it is correspondingly reduced. It is usually about 1000 c.g.s. lines per sq. cm and is comparable with that in the air-gaps of good permanent-magnet instruments. To reduce the copper drop the largest size copper wire that can be wound in the available space used. About 200 ampere-turns are normally needed. The moving coil *B* consists of about 40 turns of fine copper wire former wound, and fixed to an axle fitted with hardened steel pivots. The effect of temperature variations on the

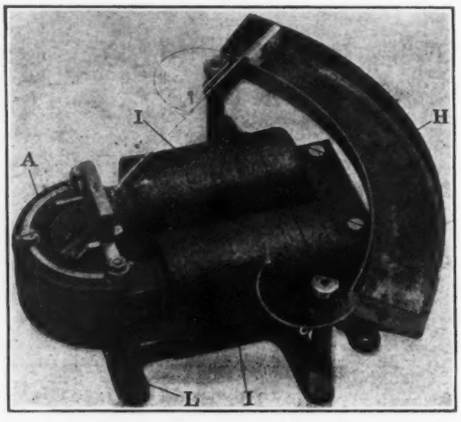
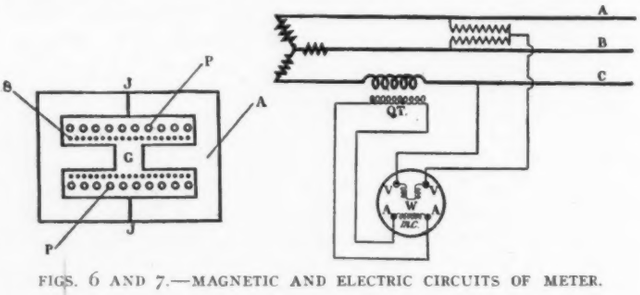


FIG. 5.—ALTERNATING-CURRENT METER.

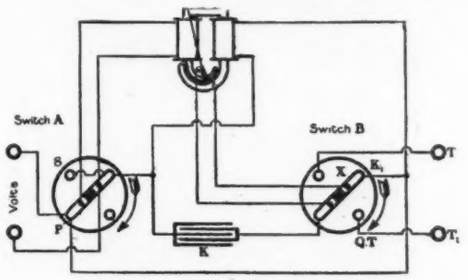
copper windings is minimized by the use of about 80 ohms of manganin wire wound non-inductively and joined up in series. This also serves to nullify the slight deflection which would be produced by induction if the terminals of the moving coil were short-circuited. The pointer carries at its end a damping vane so placed that its weight as nearly as possible balances the weight of the moving coil, and all gravity control is eliminated. An air chamber *H* for damping is provided, and the dial forms the top of this dash-pot. *I*, *I* are the exciting coils in shunt across the mains. The torque on the moving-coil system is about 1.2 gram-cm for 90 deg. deflection, which is greater than that usually employed in dynamometer or induction-type instruments. To indicate watts it is necessary to



FIGS. 6 AND 7.—MAGNETIC AND ELECTRIC CIRCUITS OF METER.

connect the electromagnet across the mains and the moving coil to the secondary of a special series transformer. The secondary current of the latter is 90 deg. out of phase with the primary and therefore in correct phase relation to the magnetic flux in the electromagnet air gap. The core *A* (Fig. 6) consists of two blocks of iron stampings with butt joints at *J*, *J* and an air-gap *G*, about one-tenth of the iron circuit. *P* is the primary winding and *S* the secondary. The latter consists of a few turns of fine wire the ends of which are joined through a high non-inductive resister to the wattmeter moving coil. This long air-gap in the quadrature transformer renders the flux proportional to the primary current and reduces the error due to hysteresis to a negligible quantity. Fig. 7 shows how the instrument should be connected for

measuring the power of a three-phase circuit with balanced load when the neutral point is not available. A specially-designed choking coil is used across two of the mains, the wattmeter itself being joined to the third main and to the junction point of the choking coil. The total power of the circuit is equal to twice the wattmeter reading. The wattmeter may be used to measure volts by changing the connections of the moving coil from the secondary of the quadrature transformer and placing them in series with a condenser of suitable capacity across the mains. The readings will be correct on circuits of any frequency or wave form, provided the ratio of voltage to frequency is not made too great so that the resultant induction density in the iron is made excessive. The instrument may be used as a portable general testing set as indicated in Fig. 8. Switch *A* enables the coils of the electro-



PORTABLE GENERAL TESTING SET.

magnet to be put in parallel or series, thus giving two scales. Switch *B* is for connecting the moving coil either in series with a condenser *K*, across one of the field coils, or directly across terminals *T* and T_1. It will be noticed that the e.m.f. applied to the condenser is the same for the same e.m.f. per turn applied to the field coils, whether these latter are series or parallel-connected. With switch *B* in the position shown, the instrument is a direct-reading voltmeter having two ranges; the readings are quite independent of frequency, wave-form, hysteresis, stray magnetic fields or electrostatic influences. When the switch *B* is turned to join the moving coil across *T* T_1, the instrument can be used for a wattmeter or for a variety of special purposes, one of the most useful being the measurement of capacity of cables and condensers. The condenser fitted in the instrument can also be employed as a standard of capacity, and a special scale can be made for the instrument, so that this is direct reading in microfarads for tests at any fixed voltage. The readings on this capacity scale will be proportional to the readings on the watt scale, and hence proportional to the square of the readings on the volt scale. For constant-voltage circuits the wattmeter can be used to measure wattless volt-amperes. For single-phase circuits all that is necessary is to substitute for the quadrature transformer a non-inductive strip resistor, to which the moving coil is suitably shunted; or, alternately, an ordinary series transformer with a secondary coil of many turns short-circuited by the moving coil. For three-phase circuits it is necessary merely to change the connections of the potential leads. The authors then describe iron-cored phasemeters. The phasemeter is merely an ohmmeter, having, in effect, an alternating magnetic needle, due to the flux caused by an alternating current traversing a moving coil, and having two alternating magnetic fields in fixed directions (but not in the same time phase) due to the cyclic currents through its fixed coils.—Lond. *Elec.*, March 20 and 27.

Wattmeter for Measuring Phase Difference.—W. Lulofs.—The author first shows that in polyphase circuits it is possible to determine the phase difference in a simply way by means of a wattmeter. He then shows that the wattmeter may also be used for measuring the phase difference in a single-phase circuit if an inductance coil is inserted in the short circuit of the wattmeter.—*Elek. Zeit.*, March 12.

Telegraphy, Telephony and Signals.

Telegraphy.—W. Bubenik.—A mathematical article illustrated by diagrams. Formulas are given for the loss of current due to imperfect insulation of the line against earth. The currents at the transmission end as well as at the receiving end depend on the insulation resistance of the line, as does also the magnetizing force of the telegraph apparatus. With a change of the insulation resistance due to weather or change of distance, etc., the magnetizing current of the instrument changes, and it may become necessary to adjust either the instrument or the voltage at the transmission end. The author prefers the last method, and shows that it is possible to subdivide the source of current so that lines of any installation resistance may be connected to the source.—*Elek. u. Masch.* (Vienna), March 15.

Telephone Exchange.—An illustrated description of the East Ham telephone exchange of the National Telephone Company which was recently opened, and which is a typical small common-battery exchange. A multiple switchboard is employed with a present accommodation for 500 lines, and an ultimate equipment of 800 subscribers' lines. Electromagnetic calling signals are used instead of lamps, and these are restored by gravity when the current is removed from the magnet coil by the insertion of the answering plug. The subscribers' operators' cord circuit is divided by a condenser instead of by a repeating coil, and a 16-cell battery is employed instead of a 11-cell.—Lond. *Elec. Eng'ing*, March 5.

Pupin Telephone Cables.—An illustrated article in which it is pointed out that with the rapid growth of large cities the municipal water pipe and gas pipe systems are growing to such an extent that it has become necessary for the sake of control to lay special telephone cables along the pipes. The cost of laying the cables is low; moreover, cables are greatly preferable to overhead wires. To reduce the cost of the cable itself, it is stated that in various German cities the Pupin system of cables loaded with inductance coils finds increasing application. So far the largest of these systems is that of the city of Schoeneberg with a cable connection between the pumping station and a canalization plant at a distance of 28 km. By using the Pupin system the cost of the cable can be considerably decreased.—*Jour. f. Gasbel.*, March 14.

Portable Telephone.—G. Foerster.—The poles supporting a transmission line are often used for the telephone wires connecting the different substations and power plant. When repairs on the transmission line become necessary it is important to be able to telephone from the place of the repair directly to the next station. A portable telephone apparatus, specially designed for such purpose, is described and illustrated.—*Elek. Zeit.*, March 12.

Controlling Apparatus from a Distance by Electric Waves.—L. Dubois.—An illustrated description of Branly's "telemechanic" apparatus for controlling electric apparatus at a distance by means of electric waves; for instance, for controlling torpedoes, starting motors, etc. The receiving apparatus consists of a steel shaft which is driven at a regular rate by a small electric motor. On the shaft are mounted a series of contact disks, each of which is designed to control one of the working circuits. Each of the disks carries an enlarged part or sector against which there bears a contact brush. Suppose there are five disks on the shaft, the five sectors are spaced over one-fifth of the circumference and there is only one of them in contact at a time. At the receiving station there is a single coherer and a sensitive Claude relay which works in connection with it, and the relay circuit is closed whenever a spark is sent from the distant operating station. In order to close the circuit at the moment when the brush makes contact with the proper disk, the operator at the sending station must be informed as to when each of the disks is making contact at the brush. Two methods for this purpose are described. However, in this arrangement accidental sparks coming from outside sources might cause trouble. For this reason Branly has modified this apparatus so that the circuit to be actuated is not closed by one or several sparks, but a continuous stream of sparks must be received within the proper operating interval. The various arrangements employed by him are described and illustrated.—Lond. *Elec.*, March 6.

Miscellaneous.

Specialization in Engineering Education.—Dalemont discusses the question whether technical schools should tend toward specialization or only toward education in general principles. He seems to be in favor of a specialized technical education to which complimentary studies should be added.—*L'Eclairage Elec.*, Vol. 53, 1907, p. 230.—Barbezat replies to the former article and compares the educational systems of England, France and Germany. He emphasizes that general education even when carried quite far, and the over-developed study of mathematics, are not superfluous or useless. They are useful and even necessary, but applications in them should be taught not by theorists, but by practical men who can verify the hypotheses on which they are based and interpret results to which they are led.—*La Lumière Elec.*, Jan. 4.—The two papers of Dalemont and Barbezat are translated in abstract in Lond. *Elec.*, March 13.—Blondel discusses the same subject at some length. He distinguishes a preparatory scientific phase, a second period devoted to general technical education and a third period devoted to special technical education. He emphasizes the practical necessity of the co-existance of various technical schools of different types and he shows that it is possible to introduce specialization and explains how far one should go.—*La Lumière Elec.*, Jan. 11, Feb. 15.—H. Bureau discusses the same problem from the standard of the young engineer in *La Lumière Elec.*, Feb. 29.

Electric Locomotives for the Detroit River Tunnel.

The accompanying illustrations show one of the six electric locomotives now being built for the Detroit River Tunnel Company by the General Electric Company and the American Locomotive Company. These locomotives will be used to haul both passenger and freight trains through the tunnel now being constructed under the Detroit River from Detroit, Mich., to Windsor, Ont.

They are moderately slow-speed machines and weigh 100 tons on the drivers. The frame is of the articulated type, and can best be described as consisting of two four-wheel trucks hinged together. The trucks are of a very solid construction with cast-steel side frames of truss pattern carried on semi-elliptical journal box springs. The diameter of the driving wheels is 48 in. The draft rigging is carried directly on the outer end frames of each truck, the two trucks being hinged together by substantial hinges and pins. By adopting this method of construction, the draft of the locomotive is carried directly through the truck frames and the center pins are relieved of all hauling strains.

The superstructure consists of a main operating cab and two auxiliary end cabs. The main cab is 15 ft. 6 in. in length and contains the engineer's operating mechanism and valves, while the contactors, rheostats and air reservoir are contained in the auxiliary cabs. The height of the end cabs is such as to permit the engineer to obtain a good view of the tracks. Easy access to the couplers is provided by a narrow platform running from the main cab to the ends of the locomotives.

The electrical equipment of each locomotive consists of four

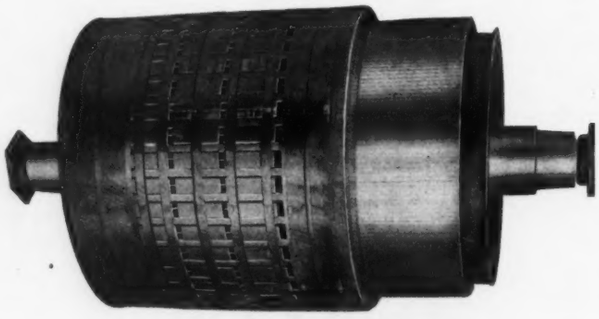


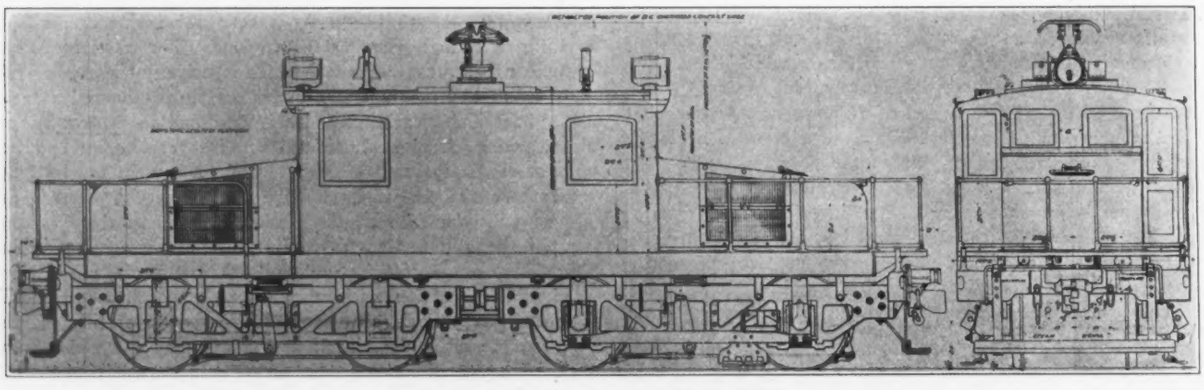
FIG. 3.—VIEW OF ARMATURE.

300-hp motors and the Sprague-General Electric multiple-unit train control. Each motor will at its hour-rating develop a tractive effort of 9000 lb. at a speed of 12 miles per hour, while a complete locomotive is capable of hauling a 900-ton train up a 2 per cent grade at the required schedule speed. The motors

FIG. 4.—SIDE VIEW OF MOTOR FIELD STRUCTURE.

are of the commutating-pole type, and are among the largest units of this type yet constructed for railway work. The current will be supplied to the motors from an inverted third-rail at a potential of 600 volts. On account of the heavy torque developed, which amounts to 4050 lb. at a 1-ft. radius, a pinion is mounted on each end of the motor shaft.

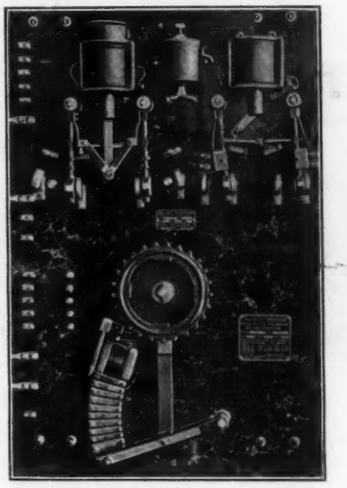
The motors will be cooled by forced ventilation, a blower having a capacity of 2000 cu. ft. per minute being installed in the main cab for this purpose. A separate compressor with a capacity of 100 cu. ft. per minute piston-displacement provides air for operating the air-brakes.



FIGS. 1 AND 2.—SIDE AND END ELEVATIONS OF DETROIT LOCOMOTIVE.

Motor Controller for Elevator Service.

The accompanying illustration shows a 10-hp, 500-volt, single-speed type of elevator controller which embodies several new features in its construction. The controlling devices are mounted on a panel 30 in. wide by 42 in. high, attached to a



AUTOMATIC CONTROLLER FOR ELEVATOR SERVICE.

channel-iron frame which supports sand-packed, tubular resistors. The front may be swung away from the frame by taking out two bolts, and as the wiring connections are arranged vertically along one side of the panel, it is not necessary to disturb these wires in swinging out the front so as to enable the wireman to trace out the circuits in case of trouble.

The double-pole, main-line switch at the upper left-hand corner is shown closed on the generative or dynamic brake contacts. When the magnet circuit of this switch is energized from the car switch, the core is pulled up, and by a toggle motion produces through a spring connection a strong pressure of the carbon buttons in the switch arms against the copper contacts located at their extremities. This coil carries considerably more current than it would stand continuously during the throw of the switches; but a resistor is inserted in series with the coil at the extreme upper limit of its throw by a switch arm, not clearly shown, but directly back of the link connecting the core with the toggle, and its resistance is such as to reduce sufficiently the current through the magnet circuit. The closing of the main-line magnet switch not only connects the motor through its resistance with the line, but simultaneously causes the magnet brake to be energized as well as the magnet of the starter clutch on separate contacts. To energize the main magnet switch, current must flow through the small contacts on the reverse switch in the right direction to feed this from the opposite sides of the line according to the position of the car switch, thus insuring the setting of the reverse switch in its proper position before the main-line switch can be closed.

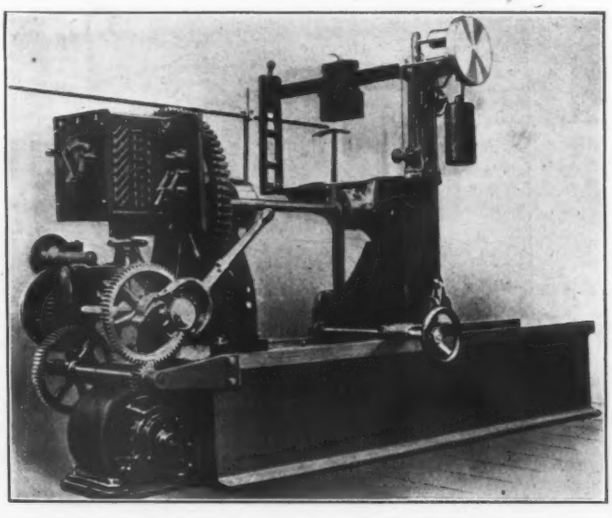
The reverse switch is shown at the upper right-hand corner of the panel. The switch has two similar arms spring-pressed to contacts, the magnet winding of which is energized only during the actual throw of the switch, current being supplied to the magnet through small contacts engaging the weight shown below the core. This weight when once set in motion by the pull of the core breaks the energized circuit and through its momentum assumes the opposite position, thus, through a crank connection, shifting the reverse switch arms. Current to energize this magnet is supplied through contacts bridged by a small solenoid in the center. This solenoid is wound in series with the shunt field coils of the motor, and as long as the shunt field coils are energized the bridge is open, thus making it impossible to produce a reverse movement on the reversing switch until the field is dead. When the main-line switch opens, the contacts close on generative brake resistance in series with a magnet winding placed above the main coil and so arranged as to pull down on the core as long as the motor continues to act as a generator, thus insuring a firm contact and preventing the reopening of this circuit instantly, which would produce arcing.

The starter is of Whittingham motor-driven type, driven either by a sprocket from an extension of the drum shaft or through worm gear by a small belt from the armature of the motor. The operation of this starter prevents an excessive rush of current and provides a time element in cutting out the resistance directly proportional to the load on the motor; as the cutting out of the resistance follows the acceleration of the armature no injurious sparking can occur on the contacts. These contacts are small flat strips of copper on which the carbon brush slides easily to the upper position. As soon as the arm is carried to the upper position by revolution of the starter clutch magnet, the small retaining magnet acts to hold the arm in that position and de-energizes the clutching magnet, at the same time the resistance arm comes in contact with the copper laminated brush, thus effectually short circuiting the carbon and producing a metallic short circuit through the starter. The starting resistance is of the Whittingham sand-packed tubular type, in which the resistance coil is supported in a glass tube bedded in sand, with copper fireproof insulated conductors leading out through porcelain bushings. This makes an almost indestructible resistance unit which meets the requirements of the Underwriters. In the larger sizes the main and reversing switch contacts are made self-aligning with spring supports so as to adjust themselves accurately to the surface of the contact arm, and in all ratings above 100 amperes, the resistance is placed below the line of the slate so as to leave the back connections entirely exposed.

The controllers are built by the Automatic Switch Company of New York City and slightly modified forms are made for controlling single and polyphase alternating-current motors.

Electric Motors in Laboratory Service.

Electricity supplied to a motor that can be relied upon is the ideal power for driving the apparatus necessary for laboratory testing. The illustration shows a typical application of a Westinghouse direct-current motor to a machine of this description. Space is generally an important consideration in a laboratory, and it will be seen that the motor fits into the ma-



MOTOR-DRIVEN TORSION-TESTING MACHINE.

chine so as to require no more space than if it were not present. The machine to which this motor is connected is an improved torsion-testing machine for testing 1¼-in. round or square specimens of any length up to 5 ft., designed and manufactured by Tinius Olsen & Company, of Philadelphia.

Motor-Starting Rheostats.

The Ward Leonard Electric Company has developed a line of motor-starting rheostats shown in the accompanying illustrations. Fig. 1 shows a plain no-voltage release motor starter; Fig. 2 shows this same starter equipped with an interlocking automatic overload circuit-breaker, which gives protection against overload and short-circuit, both during the period

FIG. 1.—MOTOR-STARTER WITH NO-VOLTAGE RELEASE.

of starting the motor and at all other times; Fig. 3 shows the resistance portion of these motor starters.

The resistance portion consists of a material composed of a special alloy having high resistivity, high fusing point and low-temperature coefficient. The resistance is attached to the back of the plate by means of suitable pins, and between the resistance coils and the slate several layers of sheet asbestos are placed, so that comparatively little heat can be transmitted to the slate. A metal casting, closed on all sides except one corresponding to the slate, is then fastened to the back of the slate, leaving a clear space between the resistance and the casting in every direction. The entire space surrounding the resistance, and the hollow chamber thus formed, is

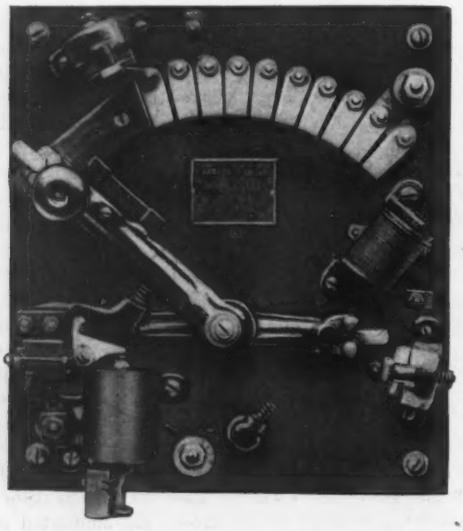


FIG 2.—MOTOR STARTER WITH OVERLOAD CIRCUIT-BREAKER AND NO-VOLTAGE RELEASE.

then completely filled with clean sand, poured in through a hole in the casting, which is afterward closed by means of a renewable plug.

Pure sand has a great many exceptionally desirable qualities for a motor starter. It has a very high specific capacity for absorbing heat energy, so that a large amount of heat can be developed in it, which will be absorbed without a great increase in its temperature. This heat will be conducted to the iron box and slowly radiated by it at a low surface temperature. It is very highly insulating, and does not absorb moisture. In case the resistance be fused by excessive current, the arc is instantly extinguished, just as in the case of an enclosed fuse. This type of resistance fulfils the latest rules and requirements

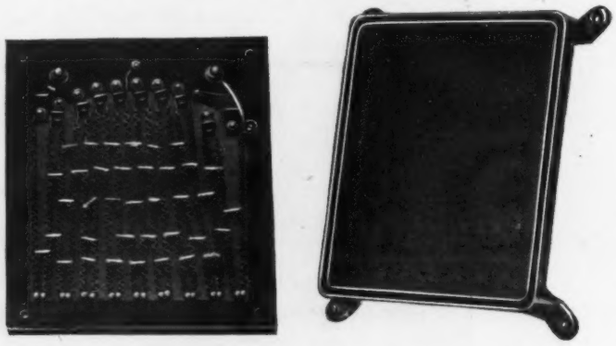
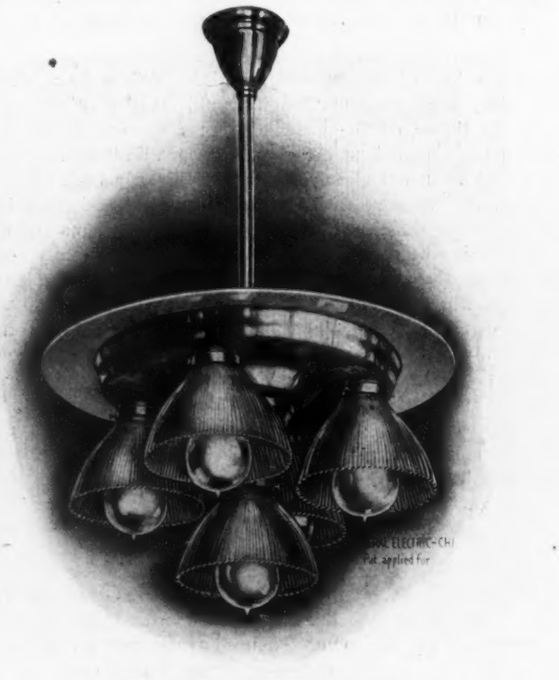


FIG. 3.—RESISTANCE PORTION OF MOTOR STARTER.

of the Underwriters' National Electric Association, which states that motor starters must be so constructed that even if the resistance conductor be fused, the arc or any resulting flame or molten droppings shall be confined within the rheostat.

Clusters for Tungsten Lamps.

The Federal Electric Company, of Chicago, has met the demand for a low-priced cluster adapted to the efficient use of tungsten lamps by bringing out the cluster shown in the accompanying engraving. This cluster is intended for the cheaper class of work where central stations wish to replace gas arc lamps with tungsten clusters and give maximum illuminating



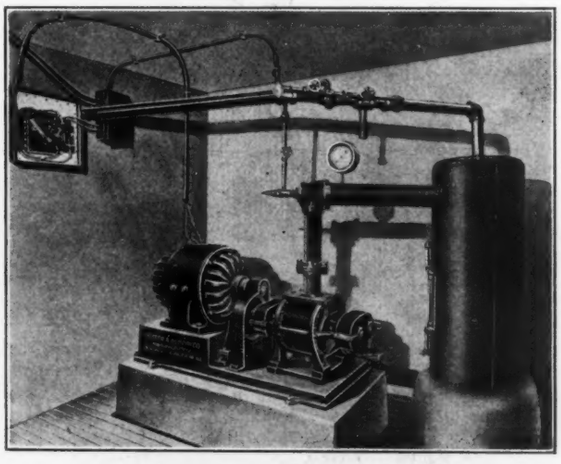
CLUSTERS FOR TUNGSTEN LAMPS.

results by using a bowl reflector over each lamp. This cluster can also be made to go directly against the ceiling without the white enameled top. If desired, a drop cord and pendant switch can be substituted for the middle lamp. The company has also recently brought out some one-light ceiling and chain pendant fixtures for large incandescent lamps.

Keystone Vacuum-Cleaning System.

The Foster & Glidden Company, of Oak Park, Ill., makes vacuum-cleaning outfits operated by electric motors, the distinguishing characteristics of which is that the pump which produces the vacuum is a Root blower operated as a vacuum pump. This company is licensed under the Root blower patents. The Root blower is applicable to use as a vacuum pump in this work by virtue of the fact that the air suction is drawn through water for the purpose of purifying the air, and in this process the air takes up enough moisture to act as a primer for the pump. The result is that a vacuum of 8 in. to 10 in. is maintained by the machine in normal operation. The friction losses of this kind of a pump are stated to be so low as materially to reduce the horse-power and weight of a machine needed to do a given work, as compared with a reciprocating pump. The pump also has the advantage that it is free from the jar and pounding of reciprocating pumps, and that it can pass any solid material drawn in through the suction without damage. The smallest outfit made, which employs a 2-hp motor, is designed to operate one utensil at a time, maintaining an 8-in. vacuum. Machines larger than this, up to 30 horse-power, maintain a 10-in vacuum.

A very interesting application of one of these machines is found in the Vaile Apartments, at Oak Park, Ill., a suburb of Chicago. It is a four-story building with 16 apartments. In the basement is a 7½-hp machine, which is designed to maintain a 10-in. vacuum with four tools in intermittent use. The pipe risers have been so placed that there is a tap in each apartment, to which hose can be attached. When any one of the tenants wants the use of the vacuum-cleaning outfit, the hose and tools are procured from a locked closet, where they are regularly kept. The absence of the hose from this closet indicates that the machine is in use by another tenant. The motor is so wired that it can be started by throwing a switch in the kitchen of any one of the apartments. When such a switch is thrown, the motor operates on current obtained through the meter belonging to the apartment in which the switch is located. Thus, each tenant operates the cleaning machine from current which he purchases. The motor is provided with an automatic-start-



MOTOR-DRIVEN VACUUM CLEANER.

ing rheostat. The owner of the building, because of this vacuum-cleaning service, charges $2.50 per month more rent for each apartment. As there are 16 apartments, this represents an income of $40 per month when all apartments are rented. This should take care of maintenance and depreciation and leave a good profit on the investment, in addition. The cost of piping a building with the necessary risers to give service in each apartment is not great, since but a small amount of pipe is required per floor. The company figures roughly that $12 per floor would cover the cost of materials and labor. The piping should be free from sharp bends where large articles are able to lodge and the construction adopted should be similar to that used in conduit for electric wires.

Porcelain Station Pothead.

The pothead or cable bell mouth illustrated herewith is intended for use in stations around switchboards where lead-covered cables terminate, as a substitute for the usual brass bell potheads. Both the bowl and the cover are porcelain. In the bottom of the bowl is a metal collar which is drilled and tapped to a size to screw upon the lead sheath of the cable. The lid fits into the top of the bowl and is provided with as many holes as there are conductors to be led through it. The advantage of porcelain over metal for the bell is that conductors can be given a greater separation and no particular care need be exercised to keep the conductors away from the

PORCELAIN POTHEAD.

sides of the bell, as would be the case if it were metal. Of course, the lid keeps the spacing of the conductors the same at all times, and if sealed, keeps out moisture and gives a finished appearance to the installation. This particular pothead does not have the disconnecting feature which is found in other G. & W. potheads. This pothead is intended simply as a substitute for metal where a permanent joint is made in the cable. It is made by the G. & W. Electric Specialty Company, 128 Jackson Boulevard, Chicago.

Induction Motor Equipment of a Copper Smelter.

It is stated that the electrical equipment of the Great Washoe smelter of the Anaconda Copper Company, at Anaconda, Mont., is unique among all plants of its kind so far built in that it includes four of the largest induction motors installed west of Niagara and was the first smelter in the country to be driven exclusively by electric motors. The concentration building is 600 ft. long. The jigs, tables, etc., are driven from a main line shaft 500 ft. long. Two induction motors are installed in each half of the mill and connected to the main shaft by rope drive and friction clutch pulleys. Each motor has an output of 1200 horse-power, synchronous speed being 360 r.p.m. Connection is made to the main shaft by 18 2-in. ropes.

These motors are notable not only on account of their large rating, but also because of their having squirrel-cage rotors, something unusual in motors of this size. Their guaranteed full-load efficiency is 91 per cent and full-load power factor 92 per cent. Squirrel-cage motors were chosen for this installation because the conditions under which they have to start are favorable and also because of the higher power factor of this kind of motor as compared with the wound rotor type.

The stator punchings of the motor are supported in a substantial yoke to which the housings carrying the bearings are bolted. The stator is wound with copper strip with the slot insulation formed around it under pressure in steam-heated molds. The rotor is mounted on a spider provided with cast steel end rings between which the laminations are held. The rotor slots are of the partially closed type, and the rotor bars are securely held in place by the overhanging tips of the teeth. The bars are bolted at each end to bronze rings, thus making

a very strong rotor that can be safely run at high peripheral speed.

In addition to the four large motors there is also provided a 200-hp, variable-speed, 60-cycle, 2080-volt induction motor for operating the pumps in the mill.

This motor is of standard type with wound rotor and collector rings for the insertion of resistance in the secondary. The normal speed is 450 r.p.m. and the speed can be reduced to 225 r.p.m. by means of a grid type resistance furnished with the motor.

The Allis-Chalmers Company, which built the motors, has also furnished for this plant three 300-kw synchronous motor-generator sets and one small induction motor generator set for starting and exciting the synchronous sets. The 300-kw sets are driven by 12-pole, 2080-volt, 60-cycle synchronous motors and run at a speed of 600 r.p.m. The direct-current generators for these sets are compound wound for 550 volts and are easily able to carry 50 per cent overload for two hours without heating more than 55 deg. C. and without sparking. At normal full load the temperature rise does not exceed 35 deg. C. in any part. The sets have three bearings and the stator of the synchronous motor is arranged to slide sideways on the base to give access to the field and armature windings. These units are to operate crane motors throughout the plant and also to furnish power for other purposes.

The fields of the synchronous motors are excited from a 120-volt, 25-kw, direct-current generator driven by an induction motor. The same motor is also coupled to a small 500-volt, direct-current machine. This machine has commutating poles, and a very large current can be taken from it for short intervals without sparking at the commutator or undue heating in any part of the machine.

Formerly all the power required by the Washoe smelter, which has been equipped throughout with electric drive, was obtained from steam engines, and a certain amount of steam power will probably always be used, as some of the steam boilers utilize the heat contained in the waste gases from the furnaces. However, this power, obtained as a by-product, is not nearly sufficient to operate the whole plant, and all additional power is now transmitted 100 miles at 50,000 volts from Canon Ferry on the Missouri River.

Locking Sockets.

While the theft of current from electric-lighting companies by dishonest meter connection, etc., has received considerable attention, but little has been said of another source of trouble of a similar nature, namely, the stealing of incandescent lamps from their sockets. Central stations whose policy it is to make free renewals find that there is a continual demand for new lamps without the exchange of burned-out lamps being offered in return, and factories, hotels and public buildings are often mulcted by their employees and patrons. The majority of the lamps are probably stolen for use by the thieves, but several instances have been uncovered where a regular trade was carried on in such lamps. The advent of high-efficiency filaments, with the greatly increased value of the lamps, has given this traffic much more importance in central-station economics, and the device shown in the accompanying illustration has been perfected to protect the companies from this loss

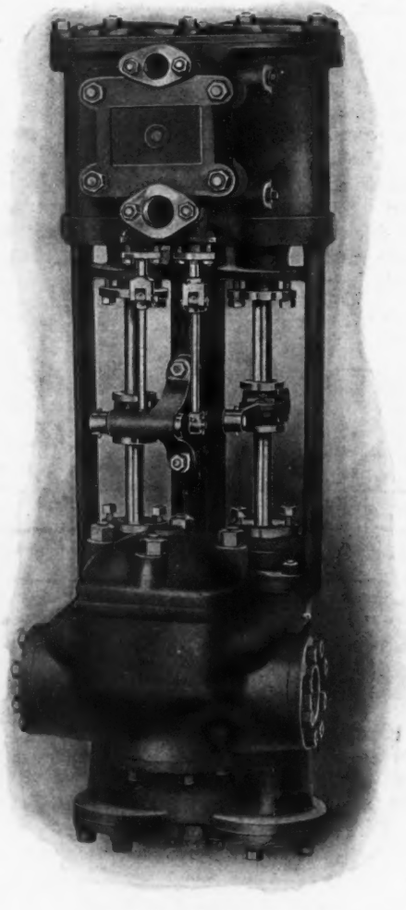
LOCKING SOCKET.

In appearance, the locking socket is similar to the ordinary key or keyless socket, the only difference being a small keyhole. The screw shell in the socket, however, swivels freely until it is locked by a key in the keyhole. To place a lamp in this socket or to remove one from it, it is necessary to lock the interior shell by use of the key before the lamp can be screwed in or out. As the lamp turns freely at all other times, it will not be broken by a person thinking it is merely stuck in the shell and trying to force it out.

The locking mechanism is safe and simple, and with the exception of the locking feature the socket has all of the characteristics of the ordinary socket and can be installed in the same manner, either on bracket, chandelier or as a pendant socket. It differs from other burglar-proof devices by being left unlocked, the key being used only to hold the inside shell rigid while the lamp is being inserted or taken out. The socket is made by the General Electric Company, Schenectady, N. Y.

New Vertical Pump.

For many years there has been a growing demand for an inexpensive vertical steam pump of small and moderate size adaptable to boiler feeding and general service, and where the modern high-working pressure necessitates substantial construction. The Blake & Knowles Steam Pump Works, of New York City, have just perfected a new design for a vertical duplex pump which meets these conditions and which is shown in the accompanying illustration. It is especially adapted for services where compactness and strength are of prime importance as in power houses and establishments where the economy of floor space is an important consideration. The pump cylinders are of the piston pattern and fitted with substantial brass linings. The pump pistons are very deep and packed with


VERTICAL STEAM PUMP.

fibrous packing suited for hot or cold water. The piston rods are of Tobin bronze and the steam cylinders are of the regular duplex pattern. The cast-iron cradle or center piece which ties the steam and water ends, is extremely rigid, an improvement on the ordinary tie-bar construction, as it prevents any possibility of the cylinders getting out of alignment. The cylinders are fitted with brackets for bolting to a bulkhead or wall, although a special base may be fitted for placing the pump directly on the engine-room floor. The pumps are suited for a working water pressure of 200 lb. per square inch.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent crop reports and the continuance of favorable weather during the last week, stimulated somewhat both the jobbing and retail trades, but fall trade reports are not any more satisfactory. The gross earnings of the railroads for March show a decrease of 10 per cent from March, 1907. Money continues to accumulate in the banks, and, while easy on call, is high on long-time accommodation, showing that the lesson of the panic has sunk deeply. Building reports from 67 large cities show an increase of 50 per cent over the preceding month, but a decrease of 39 per cent from March, 1907. The iron and steel trades are reported dull. Production in March exceeded the February output by 14 per cent, but stocks are accumulating. Steel rails are dull, but the market for structural material is good. The prices of general commodities show a tendency to recover from the downward trend of the last few months. *Bradstreet's* reports, for the week ending April 9, 258 failures, against 247 for the preceding week, as compared with 194 in the corresponding week in 1907, 161 in 1906, 196 in 1905, and 198 in 1904. In electrical fields and allied lines no unusual activity is reported, with the exception of brass and wire trades, both of which are doing a good business. One of the largest brass manufacturing firms reports an increase of more than 50 per cent over the corresponding week in March. The Western Electric Company reports that the sale of equipments to non-licensee customers for the month of April will far exceed the regular licensee business, thus demonstrating the wisdom of the company's new policy. An officer of the Westinghouse Electric Company says: "Our business is about 35 per cent less than that of a year ago, but it is surprising how well the miscellaneous orders keep up. More motors are being sold than ever before. There was a great deal of trolley work pending in the agricultural sections when the panic occurred, most of which is now held up. States like Iowa, where the agricultural wealth is great, seem to have been the least depressed, but it is there that the most projects in the transportation line have been suspended. Good crops will revive general business, principally because they will stimulate building of lines to further facilitate communication between producing areas and the centers of consumption."

THE COPPER MARKET.—With few buying orders the copper market through the week receded from its firm position and became weak and unsettled. The production for this month will be considerably in excess of the consumption, and the large dealers have been obliged to shade their prices considerably to bring inquiries from consumers. Manufacturers have fairly good orders on hand, but are not inclined to buy for the future. The United Metals Selling Company, during the week, reduced the price of the metal from 13½ to 13 cents, and at the latter price fairly good orders from Europe and from domestic consumers are reported. Apparently the foreign demand for copper at 13 cents or under is insatiable. Prices much lower than those at present are not looked for by copper experts. "I believe the metal will rest between 12½ and 13½ cents," said one of the large buyers, "until there is a decisive turn for the better in conditions." Closing prices at the Metal Exchange on Monday were as follows:

Lake	12¾ @ 12⅞
Electrolytic	12⅜ @ 12¾
Castings	12⅜ @ 12½

The London market was as follows:

	Noon			Close		
	£	s	6	£	s	d
Standard copper, spot	57	15	0	58	0	0
Standard copper, futures	58	5	0	58	10	0
Market	Steady.			Firm.		
Sales of spot	150 tons					
Sales of futures	300 tons					

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	61	0	0

STANDARD OIL NOT INTERESTED IN CALIFORNIA LIGHTING COMPANIES.—Unqualified denial was made by the officers of the Standard Oil Company of a story telegraphed from San Francisco throughout the country last week, which asserted that in a transaction involving $45,000,000 the Standard Oil Company had acquired control of the Pacific Gas & Electric Company, parent corporation controlling numerous light and power companies throughout the State. "The Standard Oil Company," said John D. Archbold, "has no interest whatever in the deal named, if such a deal really has taken place, nor has any person connected with the Standard Oil Company." Another officer of the company stated that it was believed that certain of the western power companies were about to float bond issues, and the story had probably been sent out to create a ready market for the issues.

AMERICAN GAS & ELECTRIC COMPANY.—Under the management of the American Gas & Electric Company the old properties of the Electric Company of America are showing a remarkable increase in earnings. In February the gross increased 27 per cent over the February of 1907, and the net increase was practically the same percentage. March earnings when fully compiled will make even a better showing, and it is expected that the increase will be more than 30 per cent for both gross and net. The new bonds are still in the hands of the engravers and will not be ready for delivery before May 1. After that each of the 15,000 bonds must be signed by three persons, so it will be at least the middle of May before they are ready for distribution to stockholders.

WESTINGHOUSE TURBINES.—On Dec. 31, 1907, 433 Westinghouse-Parsons steam turbines, aggregating 487,150-kw capacity, were in operation or in course of erection. At the same time there were orders on hand for 60 turbines aggregating 153,550-kw capacity. The total is thus 493 machines aggregating 640,700 kw. The average of the electric traction turbines (69) is 1975 kw and of central station turbines (73), 1440 kw. No less than 81 turbines were sold to manufacturing plants, mostly of a capacity of about 500 kw, and mining and irrigation work is represented by 19 machines of an average capacity of 686 kw.

ALLIS-CHALMERS' SALE OF MINING EQUIPMENT.—A large contract for mining machinery recently let to the Allis-Chalmers Company by the Yampa Smelting & Refining Company, Bingham, Utah, comprises an equipment for converting copper matte into blister copper, and consists of two electrically-operated converter stands with six converter shells, as well as all accessories, such as copper molds and cars, ladles, tamping machinery, a complete silica crushing plant for converter lining, with electric motors, and a cross-compound blowing engine for furnishing the blast to the converter.

ORDER FOR CABLE DETAILS.—The San Francisco Gas & Electric Company have received a large shipment of solderless cable taps comprising 200 for No. 0000 cable, 100 for No. 0 cable, and 100 for No. 2 cable for the underground department, from Dossert & Company, 242 West Forty-first Street, New York. Dossert & Company have also received a large order for solderless connectors and terminals, to be used in the wiring of the magnificent new office building for the Senate in Washington, D. C.

THE GOVERNMENT AND THE ROCKY MOUNTAIN TELEPHONE COMPANY.—A contract has recently been made by the Government with the Rocky Mountain Telephone Company, by which the 1300 miles of Government telephone wire, strung through the Government reserves in the Rocky Mountain region, will be connected with the lines of the telephone company. Settlers along the Government line will be allowed to make connections with the Government wires.

NEW GENERAL ELECTRIC BUILDING.—Work has been recommenced on three new buildings at Schenectady for the General Electric Company, the erection of which was interrupted last fall. One is a brick addition to shop No. 7, and the other two are new buildings, one of which is a five-story concrete structure, costing $60,000.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dominating the entire Wall Street situation last week, the uncertainty of the fate of the Erie Railroad kept the stock market dull and quiet until Wednesday, when it became known that the present crisis in the road's affairs had been tided over, whereupon the market began to show some signs of activity. The market was favorably affected by the government crop report, while such news as the rumored reduction of prices in finished steel products, and an investigation of Wall Street by the Legislature, had little bearish influence. New York tractions showed unexpected activity during the week. On Saturday Third Avenue closed at 36, a gain of 17 points during the week, while Brooklyn Rapid Transit and Inter-Met. stocks also showed substantial gains. Of course, there were various stories afloat to account for the advances in the tractions, but in reality there were no new developments of a character sufficiently favorable to cause any marked increase in the prices of the securities mentioned, and the advance was almost wholly due to manipulation. General Electric was also strong without any tangible reason. Those in close touch with the market characterize the trading as at present as professional, and advise their customers to wait until the market becomes less manipulative and more aggressive, or at least buy only on declines. Money is reported easier in the exchanges throughout the world. The market on Monday was almost entirely professional and stocks were heavy, many of the leading securities showing fractional declines. Closing prices on Monday were as follows:

NEW YORK.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
All-Ch.	7⅜*	7⅝	200	Int.-Met., com.	7⅞	10⅝	20,700
All-Ch. pfd.	17½*	20¼	1,800	Int.-Met., pfd.	18½*	28⅜	33,150
Amal. Cop.	58¾	57¼	123,360	Mackay Cos.	57*	59⅞	410
Am. D. T.	39*	39*	——	Mackay Cos. pfd.	65	65*	500
Am. Loc.	43¾	44¼	6,600	Met. St. Ry.	17*	33	1,650
Am. Loc. pfd.	91¼	91⅜	1,210	N.Y. & N.J. Tel.	100*	100*	——
Am. Tel & C'bl.	50*	50*	——	Steel, com.	33⅛	33⅝	204,775
Am. T. & T.	108½*	113	210	Steel, pfd.	97⅜	91¼	15,314
B. R. T.	45⅛	46⅞	43,085	W. U. T.	51	51	400
Gen. Elec.	125*	131	3,800	West'h, com.	55	54¼	10,085
Hud. R. Tel.	—	—	——	West'h, pfd.	60*	60*	——

BOSTON.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Am. Tel. & Tel.	109½	113¼	——	Mass E. R. pfd.	—	45	——
Comb'ind Tel.	—	108¾	——	Mex. Tel. pfd.	—	—	——
Edison El. Ill.	—	—	——	New Eng. Tel'p.	108	111¾	——
Gen. Elec.	126½	133	——	W'st Tel. & Tel.	6½	6	——
Mass. Elec. Ry.	10½	10½	——	W. T. & T. pfd.	62½	66	——

PHILADELPHIA.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Am. Rys.	42¾	42½	——	Phila. Elec.	7¾	8	——
Elec. Co. of Am.	9⅛	9 1/16	——	Phila. R. T.	17	17⅝	——
Elec. Stor. B'ty.	29	28	——	Phila. Traction.	—	86½	——
E. S. B'ty pfd.	—	—	——				

CHICAGO.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Chicago City Ry.	155	155	——	Met. Elec. Com	17	16	——
Com. Edison.	93	91¾	——	Met. Elec. pfd.	—	47	——
Chicago Subw'y.	18½	18	——	National Carbon.	57	58	——
Chicago Tel Co.	115¾	119	——	Nat. Carbon pfd.	107	109	——

*Last price quoted.

Shares sold are for week April 5-11.

DIVIDENDS.—Directors of the Binghamton Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 15, and the regular dividend of ¾ of 1 per cent on the common stock, as of the same dates. The regular quarterly dividend of 1½ per cent on the preferred stock and 1½ per cent on the common stock, both payable May 1, have been declared by the directors of the American Light & Traction Company. At the reorganization meeting of the directors, all the old officers of the company were re-elected. The shareholders of the Rio de Janeiro Tramway, Light & Power Company have ratified an issue of $15,000,000 of preferred stock. It is proposed to dispose of the issue in Paris. At the annual meeting of the directors of the Philadelphia Electric Company the directors and former officers were re-elected. At the annual meeting of the United Railways & Electric Company the directors were re-elected. The directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the United Electric Securities Company have declared a regular semi-annual dividend of $3.50 on the preferred shares, payable May 1, to holders of record April 21. The directors of the New England Telephone & Telegraph Company have declared the regular quarterly dividend of $1.50 a share, payable May 15. The Montreal Street Railway Company has declared the regular quarterly dividend of 2½ per cent, payable May 1. The Oklahoma Gas & Electric Company has declared the regular quarterly dividend of 1¼ per cent on its preferred stock, payable April 15. The Central District & Printing Telegraph Company has declared the regular quarterly dividend of 2 per cent, payable April 30. The San Diego Consolidated Gas & Electric Company has declared the regular quarterly dividend of 1¼ per cent on its preferred stock, payable April 15. The directors of the United States Telephone Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 15. Directors of the East St. Louis & Suburban Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the Lincoln (Neb.) Traction Company have declared the regular semi-annual dividend of 4 per cent on the common stock, payable April 15. The Savannah (Ga.) Electric Company has omitted the usual April semi-annual dividend of 3 per cent on its $1,000,000 preferred stock. The Michigan State Telephone Company has declared the regular quarterly dividend of 1½ per cent on its preferred stock, payable May 1. The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent on the common stock, payable May 15. The Grand Rapids Railway Company has declared a dividend of 1¼ per cent on the preferred stock, payable May 1. The Columbus Railway Company has declared the regular quarterly dividend on the preferred stock, of 1¼ per cent, payable May 1.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The response of the creditors and stockholders to the Merchandise Creditors' Committee's plan for the readjustment of the debt of the Westinghouse Electric & Manufacturing Company is said to promise a successful conclusion to the plan. Briefly the plan provides that (a) The holders of the merchandise debt are to take new, fully paid, assenting stock at par, in settlement of their claims. (b) Such of the bank debt as is not converted into "assenting stock" is to be provided for, partly by convertible bonds of the existing authorized issue at par, and partly by 5 per cent notes, running at least five years or an average period at least five years. (c) The existing issues of convertible bonds, debenture certificates and collateral notes are not to be distributed. (d) The stockholders are to subscribe at par for $6,000,000 of the new "assenting stock." The mortgage bond plan apparently did not appeal very strongly to the stockholders, due largely to the fact that it would have resulted in a heavy increase of fixed charges. Under the Merchandise Creditors' plan the fixed charges will be $800,000 less per annum than under the mortgage bond plan, and will assure a more speedy resumption of dividends on the company's stock. A committee of the stockholders of the Westinghouse Electric & Manufacturing Company consisting of Charles Francis Adams, Charles J. Canda, George W. Guthrie, Alvin W. Krech and George T. Oliver have issued a circular requesting the stockholders to co-operate in carrying through the Merchandise Creditors' plan. The holders of preferred and common stock are asked to subscribe for "assenting stock" of the company at par, at the rate of at least one share of new stock for every four shares of existing stock, the subscriptions to be paid for in five installments, the last being on April 1, 1909. The readjustment committee, of which James N. Jarvie is the chairman, in view of the undertaking of the Merchandise Creditors' Committee, has decided to extend the time for depositing obligations and claims until May 15, 1908. The readjustment committee states that a majority of the convertible bonds, of the three-year, 6-per-cent collateral notes and of the bills payable and a large amount of the debenture certificates and accounts payable, have already been deposited. A consolidated statement of the income of the Westinghouse Electric & Manufacturing Company for the seven fiscal years ended March 31, 1907, and for the seven months ended Oct. 31, 1907, shows that shipments billed from 1901 to 1907 increased from $15,908,154 to $33,026,240 and for the seven months ended Oct. 31, 1907, shipments billed were at the rate of more than $38,000,000 a year. The Merchandise Creditors' Committee have until June 1 to carry out their plan.

AMERICAN RAILWAY EARNINGS.—The subsidiary companies of the American Railways Company report gross March earnings of $207,774, a decrease of $19,376 from the same period last year. From July 31, 1907, to March 31, 1908, the gross earnings were $2,181,200, an increase of $59,534 over the same period in the preceding year.

WESTINGHOUSE ELECTRIC'S LIABILITIES REDUCED.—Among the liabilities of the Westinghouse Electric & Manufacturing Company, enumerated in the January report to stockholders, were certain guarantees of bank loans to the British Westinghouse Company, amounting to $621,835, and notes of the British Company discounted with the endorsement of the Westinghouse Electric & Manufacturing Company, amounting to $121,300. The total of these two items, $743,135, has been fully provided for by the British Company by the sale of $1,250,000, out of an issue of $1,500,000 prior lien debentures, which provides for all the debts of the company and leaves a cash surplus for its requirements. This sale also completes the arrangements made with the receivers of the American company, whereby the latter accepts shares of the Traction & Power Securities Company in settlement of notes and open account due the American company, amounting to about $800,000. The Westinghouse Electric Company, Ltd., of London, acting as agent for the American company, had discounted Russian Westinghouse Company bills given to the British Company, prior to the appointment of receivers for the American Company, amounting to $70,000, which have since been paid by the Russian Company. The Russian Company has also paid $95,000 on account of its overdue notes, totaling $500,000, given to and discounted by the American Company, and has agreed with the banks holding these notes to pay the remainder this year. These two payments, totaling $165,000, are in addition to $246,139 payments amounting to $246,139 made by the Russian company to the French company at about the time the receivers were appointed, for the account of the American company, thereby reducing the liability of the latter with respect to the purchase of debentures of the French company to $750,000. The total reduction in the indebtedness of the Westinghouse Electric and Manufacturing Company as of Oct. 23, secured by the payments enumerated, is $1,154,274.

PHILADELPHIA ELECTRIC COMPANY.—The report of the Philadelphia Electric Company, for the year ending Dec. 31, 1907, gives a gross income of $4,984,350, as compared with $4,503,878 for 1906. Expenses, taxes and charges were $4,075,349, equal to 9.09 per cent on the $10,000,000 paid-in capital stock, as compared with a surplus of $820,717 for the previous year. Dividends were declared of $499,935, the same as last year, leaving a surplus of $409,414, as compared with surplus of $320,782 for 1906, and a total surplus for 1907 of $2,141,934 against $1,732,519 for the previous year. President McCall stated that the policy of the company in sharing with the consumers the profits arising out of the economy of unification and increase in the growth of the business, had resulted in common benefit. He emphasized the fact that the gross income for 1907 over 1899 shows an actual increase of 121 per cent, notwithstanding the reductions in price and terms to consumers, and added that if the average price prevailing in 1899 had been maintained in 1897, the gross income would have been approximately $7,500,000, or an increase of 242 per cent, showing, he said, that the consumers of the company have practically shared equally with the company as the business has developed and grown. The report shows an increase in the number of consumers in the period mentioned of 14,828 or 182 per cent, and in connected load of 987,518 16-cp equivalent or 192 per cent. The retiring directors were re-elected. The stockholders present voted in person 15,000 shares, and the largest vote was polled in the history of the company.

RECEIVER FOR UNITED STATES INDEPENDENT TELEPHONE COMPANY.—Vice-Chancellor Howell, sitting in Newark, appointed Frederick T. Johnson, a Newark lawyer, as receiver for the United States Independent Telephone Company, of Rochester, last week. His bond was fixed at $5,000. The telephone company is a $50,000,000 corporation, and was adjudged insolvent last week because of a deficiency judgment of $16,000,000 entered against it recently in the Supreme Court of New York. Pending an appeal from the court's findings, the receivership was stayed on application of counsel for a number of creditors who have gone into a scheme proposed for reorganization. It was contended at previous hearings that M. E. O'Grady, of Rochester, who brought about the insolvency proceedings, had agreed to the proposed reorganization scheme, and that the claim of the intervening creditors had become merged in the deficiency judgment.

MASSACHUSETTS ELECTRIC COMPANY'S EARNINGS.—Gross earnings of the Massachusetts Electric Company for March show a decrease of about 3 per cent, as compared with March, 1907. It is likely that earnings for the three months ended March 31 will slightly exceed the same period of 1907. The ordinary maintenance expenditures charged to operation are but 10 per cent of what they were a year ago. This means that the fixed charges for the next year will show practically no increase. The matter of the issuance of $2,000,000 preferred 6 per cent stock of the subsidiary companies is before the Gas & Electric Light Commission for approval.

KANSAS CITY RAILWAY & LIGHT.—A report of the Kansas Railway and Light Company for February and nine months (June 1 to Feb. 29) shows a February gross of $464,118 as compared with $423,509 for February, 1907; expenses of $251,389 against $230,314 for 1907, leaving a February net of $212,729, as compared with $193,195 for February of the previous year. Deducting taxes and interest of $151,050, leaves a February surplus of $61,679 against $46,319 for the previous year. The nine months net was $2,247,542 against $2,148,097, and the nine months' surplus was $868,471 as compared with a surplus of $836,086 for the previous year.

UNITED RAILWAYS OF BALTIMORE.—The United Railways & Electric Company, of Baltimore, for the year ending Dec. 31, 1907, reports a gross income of $7,018,081, as compared with $6,853,102 for 1906; expenses of $3,470,087 as compared with $3,220,942, leaving a net of $3,547,994, against $3,632,160 for 1906. The income for 1907 was $3,554,499, against $3,636,885 for 1906. Deducting charges left a surplus of $1,066,557, as compared with a surplus of $1,271,298 for 1906. All of the directors of the company were re-elected.

UNION ELECTRIC COMPANY BONDS.—The Union Electric Company, of Dubuque, Ia., offers $125,000 first mortgage, 5 per cent gold bonds due May 1, 1924. The company has $727,000 preferred 6 per cent stock and $655,000 common stock. The authorized amount of the first mortgage, 5 per cent bonds is $980,000, of which $650,000 has been issued. For the calendar year of 1907 the gross earnings of the company were $294,922.37; operating expenses, $204,474.09, and net earnings, $90,448.28. Deducting $32,500, the interest on bonds, gave $57,948.28 applicable for dividends.

UNITED RAILWAYS NOTES.—The United Railways Investment Company announces that subscriptions have been received for the entire issue of $3,500,000 6 per cent serial notes of 1908. The note issue was to provide means to enable the investment company to acquire at par $3,500,000 of first preferred 7 per cent stock of the United Railroads of San Francisco, being the remainder of a $5,000,000 issue of that stock, of which $1,500,000 was acquired in 1907 by the United Railways Investment Company.

HAVANA ELECTRIC COMPANY.—The Havana Electric Company's report to the New York Stock Exchange for the year ended Dec. 31, 1907, gives a total income of $924,951. Deducting $13,790 for taxes and rents, $440,036 for interest and $105,050 for sinking fund installments, leaves a net profit for the year of $366,074. Deducting $275,000 as a 5½ per cent dividend on the preferred stock, leaves a surplus for 1907 of $91,074, and a total surplus of $241,795.

CONEY ISLAND ROAD TO ISSUE BONDS.—The Coney Island & Brooklyn Railroad Company last week asked permission of the Public Service Commission to issue bonds to the amount of $468,000, to be secured by the consolidated mortgage of 1904. About $278,000 of the issue, it is planned, will be used in the construction of a railway on Coney Island Avenue, from Prospect Park to Coney Island, and $83,000 of the remainder will be used in reconstructing the company's power plant.

LOS ANGELES EDISON ELECTRIC COMPANY.—For the fiscal year ended Dec. 31, 1907, the Edison Electric Company of Los Angeles, Cal., reports gross earnings of $2,206,381, operating expenses of $868,374, and net earnings of $1,338,006. Deducting fixed charges of $574,517 leaves a surplus of $763,489, as compared with a surplus of $696,724 for 1906.

PORTLAND RAILWAY & LIGHT EARNINGS.—The gross earnings for February of the Portland Railway, Light & Power Company were $332,298, an increase of $62,501, and net earnings were $157,541, an increase of $76,374 over the same period last year.

UNITED RAILWAYS COMPANY, OF ST. LOUIS.—The quarterly report of the United Railways Company, of St. Louis, shows 49,071,395 revenue passengers carried on the street cars in the three months ended March 31. The number of trips was 1,438,848.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

JASPER, ALA.—The Jasper Light & Power Company is considering the question of enlarging its power plant. J. M. Cranford is president.

GRAVETTE, ARK.—The City Council has granted a franchise to the Sulphur Springs Power & Light Company to install a lighting system in this city.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has filed a mortgage executed to the Bank of Commerce and the Trust Company, of Memphis, Tenn., for $5,000,000, of this $2,000,000 is to take up outstanding bonds and the remainder to provide for future developments.

BERKELEY, CAL.—Plans are being considered by the Board of Trustees to establish an electric lighting plant in connection with the incinerating plant, which the city is planning to erect. As a result the trustees are contemplating giving the Berkeley Electric Light Company a contract for electric lighting for one year instead of two years, as customary. The cost of the proposed plant is estimated at $15,000.

BERKELEY, CAL.—The Town Trustees have made a contract for street lighting with the Berkeley Electric Lighting Company. The town accepted the moonlight schedule at a rate of $6 per lamp per month for every month, excepting November, December, January and February, when an all-night schedule at a rate of $7 per month will be maintained. The rate for the electroliers will be $1.75 per month. The difference in the all-night schedule for the four winter months will amount to about $240 per month above the rate paid under the last contract.

GEORGETOWN, CAL.—Norval Douglass has filed notice of appropriation of 5000 in. of water in the Travis Creek below the junction of Bear Creek, the power to be used to generate electricity.

NEVADA CITY, CAL.—The Ethel Mining Company is planning to erect an electric power plant. A. Maltman is superintendent.

SACRAMENTO, CAL.—The Great Western Power Company has made application to the Board of Supervisors for a franchise to construct electrical transmission lines throughout the county, including the river islands. The company proposes to extend its lines to San Francisco. A. M. Seymour is attorney for the company.

SAN FRANCISCO, CAL.—Bids will be received at the office of the constructing quartermaster, Fort Mason, San Francisco, Cal., until May 1, for furnishing electric motor, pumps and pipe lines for the Army General Hospital, Presidio, of San Francisco. Plans and specifications can be seen and necessary information obtained at the above-named office. Major George McK. Williamson is quartermaster, U. S. A.

SANTA CLARA, CAL.—Morrison Brothers have been awarded the contract to construct the new power house for the municipal plant.

SOULSBYVILLE, CAL.—R. A. Nichols, owner of the local electric light plant is considering the question of installing a new dynamo in his plant.

UKIAH, CAL.—The Snow Mountain Water & Power Company's plant on Eel River was put into operation on March 30 and now furnishes electricity for lighting Ukiah. The transmission line will be extended to Santa Rosa in a few months and contracts for the work are already being let.

WALLACE, CAL.—The San Andreas Mining Company is planning to erect a transmission line to transmit electricity from the Emma mine property to the dredger in the river.

DENVER, COLO.—Combined with the construction of a tunnel through the Continental Divide for the Denver, Northwestern & Pacific Railroad, known as the Moffat line, is a project of bringing water through the tunnel to supply the valley below for irrigation and power purposes. The Continental tunnel will be put through at an elevation of 9000 ft., or 3000 ft. lower than the top of the Divide, and it will be 22 ft. high, 19 ft. wide and 6.04 miles in length. The estimated cost is $5,000,000 and the company will be financed by the same interests as the Denver-Steamboat Springs Construction Company, in which D. H. Moffat, D. C. Dodge, Thomas F. Walsh, John F. Campion, L. C. Phipps, H. M. Porter, Charles Boettcher, C. J. Hughes, William Byrd Page and S. M. Perry are the leading promoters. The water supply will be secured from the Snake River and other streams rising in the plateau west of the Continental Divide.

DENVER, COL.—At the annual meeting of the Northern Colorado Power Company, held April 4, a bond issue of $3,000,000 was authorized, the proceeds of which will be used for extending the transmission system of the company. The company has a plant now in operation at Lafayette, and proposes to erect transmission lines to practically every town north of Denver. The following named officers were elected: William J. Baker, president; George C. Smith, of New York, N. Y., vice-president; George Best, secretary, and Thomas Keely, treasurer.

LAS ANIMAS, COL.—Bids will be received until May 16 by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for an electric lighting system at the Navy Hospital, at New Fort Lyon. Plans and specifications can be obtained on application to the bureau or to the medical officer in command, Naval Hospital, Los Animas, Col.

GREENWICH, CONN.—The Connecticut Company is installing additional machinery to its generating plant, and is contemplating enlarging the entire plant in the near future to meet the demands made upon it. On April 1 the company put in force a new schedule of rates for electricity for lamps and motors, which reduced the cost from 30 to 50 per cent.

WILMINGTON, DEL.—Only two bids were received by the directors of the Street & Sewer Department for lighting the streets of the city. One was from the Wilmington City Electric Company for electric lighting and the other from the American Street Lighting Company for gas lighting. Both companies hold contracts for lighting the city, which have been extended until Sept. 30, 1908. Both bids were returned unopened.

WASHINGTON, D. C.—The contract for the electrical fixtures for the new municipal building has been awarded by the Commissioners of District of Columbia to the Enos Company, New York, N. Y., for $6,278.

SARASOTA, FLA.—Is is reported that H. P. Porter, of Tampa, Fla., will install a water and light plant in Sarasota.

CANTON, GA.—An electric light plant, water works and sewerage system will be installed in this city, for which $30,000 in bonds has been voted.

BURLEY, IDAHO.—Plans are being prepared by Messrs. Saunders & Vandenheuvel for the large electrical plant and pumps to be installed at the dam at this place, contracts for which, it is stated, will be let the latter part of this month.

BURLEY, IDAHO.—A. P. Davis, chief engineer of the Reclamation Service, states that the large electric plant to be installed by the government in connection with the Minedoka project will generate 16,000 horsepower, and that the government will supply electricity in Burley for heating, for operation of farm pumps and machinery. The transmission line will be extended to Burley at the close of present year.

HAGERMAN, IDAHO.—Preparations are being made by the Twin Falls Company to begin work on the construction of a large power plant on the Snake River at Lower Salmon Falls. It is expected to have the plant completed by Jan., 1909. The cost is estimated at between $400,000 and $500,000. The plant will furnish electricity for railway purposes.

SPIRIT LAKE, IDAHO.—The Spirit Lake Land Company has been granted a franchise to erect poles and wires for the distribution of electricity for lighting purposes.

BONDVILLE, ILL.—The Bondville Telephone Company is considering the question of extending its telephone lines to Mahomet.

CHADWICK, ILL.—Plans are being considered by the Farmers' Telephone Company for extending its telephone line from Chadwick to Thomson.

ORION, ILL.—H. V. Conover, clerk, writes that plans are being made to rebuild at once the municipal electric light plant which was recently destroyed by fire.

BOONEVILLE, IND.—The Evansville Terminal Railway Company has secured a franchise to cross the county with its proposed line from Evansville to Newburg.

CONNERSVILLE, IND.—Announcement has been made by the officials of the Indianapolis & Cincinnati Traction Company that plans are being made for the construction of an extension to its electric railway to close the gap between this city and Hamilton, work on which will begin in the near future. The cost of the work is estimated at $250,000.

EVANSVILLE, IND.—The Town Board has granted a franchise to the Evansville Terminal Railway Company to operate its railway through the town. The company proposes to construct an electric railway from Evansville to Newburg.

EVANSVILLE, IND.—The Evansville, Suburban & Newburg Railroad Company has applied to the County Commissioners for a new right of way through the county, and to the City Council for a right of way over Lincoln Avenue to enter the city.

LAFAYETTE, IND—A deal has been closed whereby C. L. Souders, of Lafayette, becomes owner of an independent telephone system operating in a number of towns south of Terre Haute, with headquarters in Washington. It is the intention of the new owner to improve and enlarge the system.

MADISON, IND.—It is rumored that A. A. Boyd, R. F. Garrettson, of Michigan City, and William L. Taylor, of Indianapolis, have purchased the plant of the Madison Light & Railway Company. It is understood that the new owners will rebuild and re-equip the plant.

PAOLI, IND.—Plans have been prepared for additions and improvements to the municipal electric light plant, which will include the installation of a new tubular boiler; a 75-kw, 250-volt generator; one 100-hp engine; 5400 ft. 70,000 cm cable; heater, pump and all accessories. The cost of the work is estimated at $6,000. C. D. Stinson, of West Baden, is engineer in charge.

RICHMOND, IND.—Plans for the construction of a conduit system in Main Street by the Central Union Telephone Company have been approved by the Board of Public Works, and work is to begin at once. The plans were held up for some time, with a view of providing a conduit system of sufficient capacity for all the wire companies, in compliance with an ordinance requiring the burying of all wires on Main Street. The Light, Heat & Power Company proposes to construct a pole line in the first alley north of Main Street and thus avoid its share of the cost of a conduit system.

CLINTON, IOWA.—The construction of a new office building in Clinton is contemplated by the Iowa Telephone Company, and also extensive improvements to its system in Muscatine is under consideration.

GREENE, IA.—The mill property and the water rights at this place owned by the Greene Manufacturing Company have been sold to the Greene Electric Light & Power Company for $3,500. The dam, which was recently washed away, will be rebuilt and will furnish power to operate the electric light plant and the flouring mill.

AKRON, KAN.—The Farmers' Telephone Company is contemplating improvements and extensions to its system in this city, including the installation of a new switchboard.

WINFIELD, KAN.—Bids will be received until April 29 by the State Board of Control, Topeka, for a 75-kw direct-current generator and engine for the School of Feeble Minded Youth, Winfield. Also for remodeling the boiler.

WINCHESTER, KY.—Extensive improvements are planned by the Old Kentucky Telephone & Telegraph Company including the installation of a new switchboard, placing its main wires in cables and thoroughly overhauling the entire system.

LECOMPTE, LA.—Bids for the construction of the municipal electric light plant, which were opened April 7, have been rejected and further action on the matter deferred until Feb. 1, 1909.

NEW ROADS, LA.—The Cumberland Telephone Company is contemplating extending its line from Port Allen to New Roads, which will ultimately be extended to Torras, a distance of about 35 miles.

SHREVEPORT, LA.—The Shreveport Telephone Company is preparing to extend its underground and cable systems.

VASSALBORO, MAINE.—Plans are being considered by the Vassalboro Electric Light & Power Company to develop the water power at the outlet of China Lake to generate electricity. The company proposes to develop about 200 horse power and will furnish electricity in the towns of Vassalboro and Winslow for lamps and motors. Edward Chase, of Winslow is interested in the enterprise.

WINSLOW, MAINE.—The dam of the Fort Halifax Power Company is nearly completed and work has commenced on the construction of the power house. The equipment will include eight Hercules water wheels made by the Holyoke Machine Company, of Holyoke, Mass., with an aggregate rating of 2800 horse power; three generators and exciters from Fort Wayne Electric Works. The plant will have an output of 2100 kilowatts. There will be two units, one of which will be a three-phase, 25-cycle, 400-volt, alternating-current, the other a double-current generator furnishing three-phase, 25-cycle, 400-volt current on one side, and at the other 60-cycle, 4100-volt. The transmission line will be 50 miles in length, and will furnish electricity to operate the Lewiston, Augusta & Waterville Street Railway.

HAGERSTOWN, MD.—The municipal electric light plant has made an excellent showing the past year, the receipts showing an increase of $4,516 over last year. A new 500-hp condenser has been ordered, which will cost about $1,500.

BEVERLY, MASS.—The Beverly Gas & Electric Company has announced a reduction of 10 per cent in its price for gas and electricity. Under the new schedule the price of electricity for lamps is 15 cents per kw-hour, with a discount of 20 per cent instead of 10 per cent for all bills paid on or before the 15th of the month. The present price is 13½ cents per kw-hour, with a discount of 10 per cent. The new schedule goes into effect July 1, 1908.

FITCHBURG, MASS.—Arrangements are being made by the Fitchburg Gas & Electric Company to place its wires in underground conduits during the coming summer.

GRAFTON, MASS.—The citizens have voted to authorize the Selectmen to enter into a contract with the Grafton Electric Company for lighting the streets of the village for a term of five years at the rate of $13.50 each per year for 25-cp incandescent lamps. A committee was also appointed to investigate and report on the advisability of installing a municipal electric lighting system and to report Aug. 22.

PEABODY, MASS.—The citizens have voted to appropriate $2,500 to install and maintain an incandescent street lighting system on Lowell Street in West Peabody.

PITTSFIELD, MASS.—The city has renewed the street lighting contract with the Pittsfield Electric Company for another year under the same terms as last year. The company is to furnish 130 arc lamps at $79 each per year and 725 incandescent lamps at $17.25 per lamp per year. All lamps to be operated on an all-night schedule. Under the terms of the contract the company is to substitute tungsten lamps of 32-cp for the 25-cp incandescent lamps now in use. The company also agrees to reconstruct nearly all the arc lamps in use.

SHARON, MASS.—The town of Sharon is considering a proposition of making a contract with the Edison Electric Illuminating Company, of Boston, for a term of 20 years, the company to furnish incandescent lamps for street lighting for $12 per lamp per year, instead of $15 per lamp. Electricity for lighting the town is furnished from the Medfield plant.

WAKEFIELD, MASS.—The managers of the municipal electric light plant are considering plans for installing gas engines and gas producers in the municipal electric plant, and would like to correspond with manufacturers of the same.

WESTFIELD, MASS.—The Bigelow Boiler Company, of New Haven, Conn., has been awarded the contract for installing a 150-hp tubular boiler in the municipal electric light plant. George Pettibone is manager of the plant.

WILMINGTON, MASS.—The citizens have voted against the proposition to light the streets of the town by electricity. It was proposed to make connection with the Reading municipal electric plant, which would have involved an expenditure of $12,000. The cost of maintenance for the first year was estimated at $2,300.

HOUGHTON, MICH.—Plans are being considered by the Michigan Telephone Company for extensive improvements to its local plant.

MARQUETTE, MICH.—The municipal electric light plant has just closed the most successful year of its existence. The receipts for the past 12 months were $55,527; the operating expenses, including depreciation and new construction, $22,580, and the net earnings $32,527. Interest on bonds amounted to $3,239, leaving a net revenue of $29,288. The rates for electricity for lamps for commercial purposes are five cents per kw-hour, and for residences seven cents per kw-hour. The plant is operated by water power.

UNION CITY, MICH.—The city has decided to repair and improve the pole lines of the municipal electric light plant, at a cost of about $2,000. J. G. Wetmore is superintendent.

BELGRADE, MINN.—Plans are being made by T. J. Anderson, of this city, to erect a new telephone line from Belgrade to Eslarm.

BIWABIK, MINN.—Plans are being considered for increasing the boiler equipment of the municipal electric light plant.

DETROIT, MINN.—Plans are being made to construct a rural telephone line from Lake Sally and Lake Melissa districts. The Union Telephone Company will erect a line from Osage to Detroit.

LUVERNE, MINN.—The Council contemplates removing the municipal electric light plant and water works system to another location, and installing new machinery at a cost of $15,000.

ST. CLAIRE, MINN.—The Village Council has granted the St. Claire Telephone Company a franchise to install and operate a telephone system.

SPRING VALLEY, MINN.—The Northwestern Telephone Company has sold its telephone system in this place to the Tri-State People's Telephone Company. The company operates about 150 telephones.

JACKSON, MISS.—J. W. Abernathy is interested in a project to build an interurban railway to connect the towns of Hazlehurst, Brown's Wells, Barlow and Dentville. The road will be about 40 miles in length.

NATCHEZ, MISS.—Plans are being made for laying the submarine cable of the Cumberland Telephone & Telegraph Company to connect Natchez and Vadalia, La., to replace the one lost last year. J. T. Featherston is general superintendent of construction.

FARMINGTON, MO.—Plans are being prepared for a municipal electric light plant, the cost of which is estimated at $25,000. Thomas B. Carter is engineer in charge.

ST. JAMES, MO.—The St. James Ice & Power Company is making preparations to construct an electric light plant and cold storage plant in this city, the cost of which is estimated at about $24,000. The company is now receiving estimates for the equipment of the plant. Louis Decker, of St. Louis, is interested in the project.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company contemplates the construction of an interurban railway to Savannah. The cost of the work is estimated at $300,000. Plans are also being considered by the company to enlarge its power plant at Main and Felix Streets, which will involve an expenditure of about $50,000.

ST. LOUIS, MO.—President O'Reilly of the Board of Public Improvements has asked the City Counselor for an opinion on the legality of the franchise obtained by the Trans-Mississippi Electric Company, in 1897, to string wires and lay conduits for lighting purposes. The company filed an acceptance of the ordinance at the time, but did not file a bond. Recently it applied to the board for permission to establish conduits and erect wires in the districts bounded by Euclid Avenue, Lindell and Forest Park Boulevards and King's Highway.

ST. LOUIS, MO.—L. Frank Ottofy, attorney for Browning, King & Company, states that the company owns a franchise to manufacture and sell electricity for lamps and motors, and that plans are under consideration for the construction of a large plant. The company proposes to operate a general commercial lighting business in competition with the Union Electric Light & Power Company. The company has a perpetual franchise obtained from the city in March, 1884, under the terms of which it is to pay the city 2½ per cent of its annual gross receipts until 1900, and thereafter 5 per cent. The company accepted the ordinance and filed a $20,000 bond, which is still in effect.

TERRY, MONT.—The Terry Telephone Company is in the market for equipment for a telephone system, including switchboard, wire, cable, insulators, instruments, etc.

FREMONT, NEB.—In addition to the extensive improvements and extensions being made by the Fremont Telephone Company to its local system, it is proposed to build a number of new lines.

UPLAND, NEB.—To meet the requirements of its increasing business the Upland Telephone Company has decided to build a new exchange building. The system will be improved and a new switchboard installed.

RENO, NEV.—The Selby Consolidated Mining Company has closed a deal with the Truckee River General Electric Company for the installation of electrical machinery and to furnish electricity for the operation of a 60-ton Kinkead mill to be installed in the new camp in the Jumbo mining district.

SALEM, N. H.—The mill formerly owned by James Dustin, of North Salem, has been purchased by the Salem Light, Heat & Power Company, and will be equipped with modern machinery and used as a power station. The new plant will be operated by water power. E. R. Woodbury is superintendent.

BOUND BROOK, N. J.—Plans are being considered by the Home Telephone Company for improvements to its system in this city, involving an expenditure of about $10,000.

HOBOKEN, N. J.—Plans are being made by the New York & New Jersey Telephone Company to place all its wires underground in this city by Aug. 1. The cost of the work is estimated at nearly $50,000. It is the intention of the city to compel the Public Service Corporation and the Western Union and Postal Telegraph companies to place their wires underground.

PRINCETON, N. J.—Plans have been prepared for the construction of a new power house for the Princeton Theological Seminary. The building will be erected by William T. Matthews at a cost of $13,800. The Richard D. Kimball Company, of Boston, Mass., have charge of the construction of the plant.

SORCORRO, N. M.—Plans are being made to install an electric light and power plant. Dr. E. L. Woods is interested in the enterprise.

BERGEN, N. Y.—The Village Board is negotiating with the Genesee County Electric Light, Power & Gas Company to furnish electricity for lighting the village. The streets have been in darkness for several weeks.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has applied to the Public Service Commission asking for permission to issue bonds to the amount of $462,000, to be secured by a consolidated mortgage of 1904. Of the proceeds $278,000 will be used for the construction of the railway on Coney Island Avenue from Prospect Park to Coney Island, the balance to be used for reconstructing the company's power plant.

CANANDAIGUA, N. Y.—The cars of the Rochester & Eastern Rapid Railway Company are now operated by Niagara power furnished by the Niagara, Lockport & Ontario Power Company. The power house of the railway company will be maintained, and for the present operated part of the time. The power company also furnishes electricity for lighting the streets of the town.

FULTON, N. Y.—In order to hasten the work on the barge canal the contractors are about to build a coffer dam which will shut off the entire water power of the Fulton Light, Heat & Power Company, and throw the company entirely upon its steam reserve plant.

HEMLOCK, N. Y.—The Canadice Telephone Company, recently organized, has completed its telephone line to this place and has established connections with many of the surrounding towns. It is planning other extensions.

INWOOD, N. Y.—A committee has been appointed by the Village Improvement Society to make arrangements to form a lighting district and make provision for lighting the streets of the town.

PATCHOGUE, L. I., N. Y.—The Village Board has rescinded its action of April 6 to enter into a five-year contract with the Patchogue Electric Light Company to furnish 25-cp incandescent street lamps for $18 per lamp per year. The matter was referred to a special committee.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings until April 20, for installing electric equipment in addition to and alterations in Public School No. 3, Borough of Bronx; also in Public School No. 4, Borough of Manhattan.

SPENCERPORT, N. Y.—The Ogden Telephone Company has placed a contract with the Inter-Ocean Telephone Company, of Buffalo, for the construction of a new telephone system for $16,000. The contract calls for 400 telephones and two exchanges, one in this village and the other in Adams Basin. The line is to be completed by July 4, 1908.

UTICA, N. Y.—Clifford Lewis, Jr., of this city, is conducting a survey in Fulton County for the Garoga Valley Electric Light & Power Company, a new company recently organized. The company is capitalized at $1,000,000 and is placing contracts for furnishing electricity in Amsterdam and Schenectady.

SALISBURY, N. C.—Owing to certain restrictions in the franchise granted by the Board of Alderman to the Southern Power Company to erect an electric plant in this city, the company refused to accept the franchise, and it is possible that the franchise may be revoked.

WINSTON-SALEM, N. C.—Preparations are being made by the Southern Bell Telephone to install a new telephone system in this city, including the erection of a new exchange building, the cost of which including the equipment is estimated at $35,000.

MINOT, N. D.—Plans are being considered for organizing an electric light company here. K. C. Sanborn is interested in the project.

COLUMBUS, OHIO.—A bill has been passed by the Senate giving a city or Village Council power to purchase water works and electric light plant, when owned and operated as one property by a private company, provided a majority of the people so decide at a special election for that purpose. The bill was introduced for the relief of the situation that has developed at Warren.

COLUMBUS, OHIO.—Proposals will be received by the Board of Public Service until April 20, for furnishing the following supplies for the municipal electric light plant: 125,000 ft. No. 8 Brown & Sharp gauge, triple braid, weather proof solid copper wire; 125,000 ft. No. 6 Brown & Sharp gauge, triple braid, weather proof solid copper wire; 15,000 ft. No. 8 Brown & Sharp gauge, single braid, rubber covered standard copper wire. All wire to conform to the national electric code rules and requirements. Each bidder must submit samples of the wire bid upon and also state the shortest time of delivery of all or part of wire. For further information address E. W. Hirsch, Secretary Board of Public Service.

DENNISON, OHIO.—The United Electric Company has made extensive additions and improvements to its plant, including the installation of a 200-kw, 2200-volt, 60-cycle, three-phase belted generator and 50 Westinghouse arc lamps, and also expects to install 50 additional arc lamps. The lamps are operated from a mercury arc rectifier. O. B. Welch is manager.

LIMA, OHIO.—W. Kesley Schoepf, president of the Ohio Electric Railway Company, has informed the City Council that his company will furnish street lamps at $70 per lamp per year on the renewal of the contract, which is a reduction of $15 per lamp now being paid on the old contract. The Council has already voted a bond issue for a lighting plant.

LOGAN, OHIO.—Bids will be received by the Village Council until April 28, for lighting the streets, alleys and public places for a period of 10 years; also for a period of three years, from Aug. 1, 1908, with not less than 50 arc lamps of 2000 cp. D. V. Thurness is Mayor.

RAVENNA, OHIO.—The Ravenna Gas & Electric Company has increased its capital stock from $60,000 to $120,000.

KLAMATH FALLS, ORE.—Three large plants are now in course of construction in Klamath County. The largest is the Southern Pacific plant at Spencer Creek, which will take three years to construct. The next in importance is the government plant to be built on Link River, in conjunction with the Keno Canal. It will have an output of 1600 horsepower and will furnish electricity to operate all the pumping stations in the various parts of the Klamath project. The last is the Moore power plant, which is located a short distance down the river from the government site, which will be completed this year, and will furnish electricity for lamps and motors in the towns of Bonanza and Merrill. The transmission lines are nearly completed to both towns.

UNION, ORE.—The City Council has passed an ordinance providing for submitting to the citizens at the June election a proposition to amend the city charter so as to empower the city to incur an additional indebtedness of not to exceed $55,000 for installing an electric light plant and improving the water system. The Mayor and Recorder have been empowered to at once take steps to carry out the orders of the Council.

CORRY, PA.—The plants and holdings of the Corry Electric Light Company have been sold to James E. George, of Cleveland, Ohio. It is understood that the new owner will improve the plant.

CRESSON, PA.—Arrangements are being made by the American Union Telephone Company to install a new exchange in this city and to establish connections with Loretto, Ashville and other surrounding towns.

ELK LICK, PA.—The Pennsylvania & Maryland Street Railway Company has filed a notice with the Secretary of State of an increase of bonded indebtedness from nothing to $1,000,000.

HUNTINGDON, PA.—The Raystown Water Power Company has filed a notice with the Secretary of State of an increase of capital stock from $5,000 to $750,000; also an increase of bonded indebtedness of the same amount was filed. The company is building a large power plant in Huntingdon, and proposes to furnish electricity to the Pennsylvania Railroad Company and towns in this vicinity.

LEWISBURG, PA.—Extensive improvements are contemplated by the Buffalo Valley Telephone Company to meet the requirements of its increasing business.

NEW CUMBERLAND, PA.—The Borough Council of Goldsboro has accepted a plot of ground along the Little Conewago Creek from Clarence Williams, a business man of the town, for a site for a municipal electric light plant. An ordinance was recently passed appropriating $9,000 for the construction of an electric light plant, work on which will commence at once. The street lighting system will consist of 25 arc lamps.

SOUTH CANAAN, PA.—The Southeastern Telephone Company contemplates the construction of new lines to South Canaan and other points.

GREENVILLE, S. C.—Surveys are being made by the Southern Power Company for its transmission lines from Spartansburg to this city. The

company will furnish electricity in this city as soon as its lines are completed.

WALLACE, S. D.—The Wallace Farmers' Telephone Company contemplates the installation of a new telephone system and other improvements to its plant.

BROWNSVILLE, TEXAS.—The power house of the Brownsville Light & Power Company was completely destroyed by fire on April 4, and the streets of the town are in darkness. The plant will be rebuilt as soon as possible.

CHILDRESS, TEX.—The Childress Ice & Light Company, recently incorporated, will install an electric light plant and ice factory. P. C. Maricle is manager.

GOLIAD, TEX.—Plans are being considered by the Chilton Electric Light Company to construct an electric light plant, the cost of which is estimated at $2,100. L. W. Chilton is manager.

HEREFORD, TEX.—A franchise has been granted to Messrs. Obethier & Meadows to construct an electric light plant. The equipment will include a 75-kw, 60-cycle generator and a Corliss engine.

JACKSONVILLE, TEX.—The City Council has granted a franchise for the electric interurban railroad, being promoted by H. L. Norton, of Boston, Mass., through the streets of Jacksonville. The railway will connect Jacksonville and Alto and intervening towns.

HOUSTON, TEX.—The Houston Home Telephone Company has purchased a site for its new telephone exchange in this city. The company proposes to install a cable plant.

MEMPHIS, TEXAS.—Plans are being made to enlarge and improve the local telephone system, including the installation of a new switchboard and erecting additional wires and cables. Horace Gooch is owner of the system.

PORT ARTHUR, TEX.—The Port Arthur Water Company contemplates installing an electric power plant to furnish electricity for motors. It is stated that two units of 1500 hp will be installed.

TAYLOR, TEX.—The Citizens' Light & Power Company has taken over the plant and holdings of the Taylor Electric Light Company. The new company will enlarge the power house and install new machinery. The officers of the company are: T. W. Marse, president; E. A. Robertson, vice-president; C. B. Challenner, secretary, and C. H. Booth, treasurer.

WACO, TEX.—The Brazos Valley Telephone Company is planning to rebuild its plant in Waco, and improve its system in Moody.

FOREST DALE, VT.—The Selectmen have entered into a contract with the Neshobe Electric Company, of Brandon, to light the streets of the village. The contract calls for 45 incandescent lamps of 16 candlepower.

ROANOKE, VA.—The Common Council has awarded the contract for lighting the city for a term of five years to the Roanoke Water Power Company. Under the terms of the contract the company is to furnish arc lamps at $49 per lamp per year. The city is now lighted by the Roanoke Railway & Electric Company at $70 per lamp per annum.

ROCKYMOUNT, VA.—The Franklin County Telephone Company is in the market for 600 cross arms and 2000 insulators.

DAYTON, WASH.—Announcement has been made that the Columbia & Walla Walla Traction Company will commence the construction of part of its road this season. The road will be 80 miles in length and will connect Dayton and Wallau and intervening towns. It is stated that the power station will be located on the Tocannon River. M. C. Moore, of Walla Walla, is president, and J. H. Morrow, of Waitsburg, general manager.

OLYMPIA, WASH.—The Pacific Power & Railway Company has notified the State Land Commissioner that it will apply for condemnation and appropriation of the water of the middle fork of the Toutle River, in Cowlitz County. The water is to be used for power purposes.

SEATTLE, WASH.—Contracts will be awarded by the Board of Public Works within the next 30 days for the iron poles and cluster lamp fixtures for First and Second Avenues from Jackson to Cedar Streets. The cost of the work is estimated at more than $60,000.

TACOMA, WASH.—F. G. Simpson, the electrical engineer, appointed by the city to investigate the municipal electric lighting plant and its operation, recommends that a commission of engineers be appointed to make plans for a city lighting plant with an output of not less than 10,000 horse-power.

WENATCHEE, WASH.—A right of way has been secured by the Entiat Power Company for its transmission line from Entiat to Wenatchee, and construction work will begin in June. Electricity will be furnished to ranches on the Columbia and Entiat rivers.

WHITE SALMON, WASH.—The Town Council has granted a franchise to Messrs. Shepler & Rogers to install an electric lighting plant.

BURKHARDT, WIS.—Plans are being prepared by Edward P. Burch, of Minneapolis, Minn., consulting engineer, for remodeling the electric plant and distributing system of the Burkhardt Milling & Electric Power Company.

CHILTON, WIS.—The State Railroad Commission has denied the petition of the city of Chilton for permission to erect a municipal electric light plant to compete with the Wisconsin Electric Service Company. The Council and the company have not been able to agree for some time. The company offered to sell its plant to the city for $20,000, which it claims is $10,000 less than it cost.

LOYAL, WIS.—The Village Board is in the market for direct-current meters to be delivered in small quantities throughout the year. A contract will probably be awarded on April 23.

MANITOWOC, WIS.—The Newton & Osman Telephone Company will construct a telephone line between Newton and Osman, and install a switchboard in each city.

MILWAUKEE, WIS.—The building committee of the Auditorium Board has decided to recommend the adoption of plans for installing a complete plant to furnish heat and power for the building. The cost of the plant is estimated at $10,000.

SPRING BROOK, WIS.—Plans are being made by N. D. Sergeant for the construction of a rural telephone line from this city north into the Gull Lake territory.

CALGARY, ALB., CAN.—The power and light committee is considering the question of installing an additional engine, which will practically double the output of the civic power plant. For further information address Chairman Creaves. At a meeting held recently the committee made arrangements for another reduction in the price of electricity for lamps.

EDMONTON, ALB., CAN.—Griffin & Company, who are now building a packing plant on the outskirts of this city, will install an electrical generating plant to furnish electricity for lamps, heating and motors in their plant.

EDMONTON, ALB., CAN.—Messrs. Cannel & Spencer have been awarded the contract for the construction of the power house to be built in connection with the general hospital for $40.000. R. P. Barnes is the architect.

LETHBRIDGE, ALB., CAN.—The City Council has decided to engage Cecil B. Smith, C. E., of Toronto, to report on the local power proposition.

RED DEER, ALB., CAN.—The Alberta Government will soon construct a rural telephone line between this city, Edwell and Pibe Hills. S. Edward, of Edmonton, Alb., is superintendent of construction.

WINNIPEG, MAN., CAN.—Arrangements are practically complete for the purchase of the street railway system of Winnipeg by the city. The deal involves a cash outlay of more than $13,000,000 and includes all the equipment owned by the Winnipeg Electric Company, consisting of the electric power plant at Lac du Bonnet, street railway system in Winnipeg, gas plant, substation of the Winnipeg, Selkirk & Lake Winnipeg Electric Railroad. It is understood that the city will be required to buy up all the stock of the company at the Toronto quotations.

FORT WILLIAM, ONT., CAN.—The Bell Telephone Company has submitted a proposition to the Town Council to sell its local telephone plant to the town for $6,000.

OTTAWA, ONT., CAN.—The bill to incorporate the Ontario & Michigan Power Company, giving the company power to develop water power on the Pigeon, Sturgeon and Nipigon rivers, and to export power to the United States was defeated in the Senate railway committee.

GOMEZ DEL PALACIO, MEX.—The F. C. Electric de Lerdo Torreon is contemplating building a new power house in Torreon and installing two 400-hp suction gas units. E. P. Stein, of Gomez Palacio, is manager.

New Industrial Companies.

THE TERRY ENGINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000. The directors are George H. Terry, C. A. L. Brown and Clifford H. Eagle, of New York, N. Y.

THE BESSEMER GAS ENGINE COMPANY, of Robinson, Ill., has been incorporated with a capital stock of $200,000 by H. B. Willower, of Robinson, Ill. The company proposes to deal in engines and machinery.

THE UNITED ENGINEERING & CONTRACT COMPANY, of Dover, N. J., has been incorporated with a capital stock of $250,000 by T. E. Cheyney, G. H. Evans, of Philadelphia, Pa., and R. B. Kenney, of Dover, Del.

THE ELECTRICITY PUBLISHING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000. The incorporators are: E. Leavenworth, John G. Jackson, and Joel B. Liberman, of New York, N. Y.

THE AUTOMATIC CONSTRUCTION COMPANY, of Houston, Tex., has been incorporated, with a capital stock of $35,000, by F. G. Read, S. P. Kelley and J. S. Slusher. The company proposes to construct an automatic telephone system in this city.

THE GILMORE ARC HEADLIGHT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $3,000 by Alfred C. Gilmore, Roscoe L. Wickes and Frederick Arnd. The company proposes to do a general manufacturing business.

THE MOYER ENGINEERING & CONSTRUCTION COMPANY, of Newark, N. J., has been chartered to carry on a contracting and construction business. The incorporators are: John E. Helm, H. Dye, John G. Van Blarcom, all of Newark, N. J.

THE EBERSOLE CONSTRUCTION COMPANY, of Portland, Maine, has been incorporated, with a capital stock of $200,000, for the purpose of constructing telephone and telegraph lines. E. E. Ebersole is president and E. A. Ebersole clerk, both of Portland, Maine.

THE SHEFFIELD ELECTRICAL COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $5,000, to manufacture gas and electric lamps, fixtures, etc. The incorporators are: William A. Paulson, John L. Pohl, Edward S. Smith and others, of Brooklyn, N. Y.

THE SANDO ENGINEERING COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $25,000, for the purpose of carrying on a general engineering business. The officers are: D. A. Decrow, of Buffalo, N. Y., president; W. J. Sands, of Milwaukee, Wis., treasurer.

AXLE CUSHION & MOTOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000, for the purpose of manufacturing motors, engines, machinery, etc. The incorporators are: Joseph B. Roberts, Leon B. Leavitt, Herbert B. Shonk, and others, of New York, N. Y.

THE WITCH MANUFACTURING COMPANY, of Portland Maine, has been organized with a capital stock of $20,000, for the purpose of doing a mechanical and electrical engineering business. The officers are: James E. Manter, president; Clarence E. Eaton, treasurer, both of Portland, Maine.

THE LUTZ-LOCKWOOD MANUFACTURING COMPANY, of Roselle, N. J., has been incorporated with a capital stock of $100,000 by Richard M. Barwise, Whittemore Dodd and Charles W. Low, of Roselle, N. J. The company proposes to manufacture electric batteries, supplies, motors, vehicles, machinery, etc.

THE CAWLEY-BOETTIGER ENGINEERING COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $15,000, to carry on an engineering and construction business. The incorporators are Philip Boettiger, Michael J. Cawley, Franklin C. Haven, of Brooklyn, and Oscar Storck, of the Borough of Bronx.

THE AUTO-SECURITY EQUIPMENT COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $27,000, for the purpose of manufacturing automobiles, motors, electrical devices, etc. The incorporators are Woolsey A. Shepard, William P. Hammond, Augustus S. Houghton, of New York, N. Y.

THE DELANEY-ROBERTS COMPANY, of New York, N. Y., has been chartered for the purpose of carrying on a general engineering and construction business. The capital stock of the company is placed at $5.000 and the incorporators are Harold B. Roberts, of Pelham; Leonard B. Le Vake and John M. Delaney, of New York, N. Y.

THE EMPIRE EQUIPMENT COMPANY, of Schenectady, N. Y., has been incorporated with a capital stock of $50,000 by P. M. Pfell, of Pittsburg, Pa.; J. H. Van Alstine, Arthur C. Mills, of New York; Charles L. Steinrock and H. W. Bachelder, of Schenectady, N. Y. The company propores to do a general engineering and contracting business.

THE CENTRAL CONSTRUCTION COMPANY, of Omaha, Neb., has filed articles of incorporation, with a capital stock of $200,000. The purpose of the company is to construct long-distance telephone lines in Nebraska. The incorporators are Charles G. Cockerill, Jefferson, Ia.; C. H. Smith, of Sioux City, Ia., and J. E. Baum, of Omaha, Neb.

THE STANDARD AUTOMOBILE COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing compressed air, electricity and carrying on a general mechanical engineering business. The incorporators are R. H. Stamper, D. H. Goff, of Camden, N. J.; J. W. Stamper, of West Philadelphia, Pa., and R. Miller, of Philadelphia, Pa.

Company Elections.

HUMBOLDT, KAN.—At the annual meeting of the Humboldt-Speiser Telephone Company the following named officers were elected: C. Lionberger, president; J. R. Hunzeker, vice-president; R. F. Conrad, secretary and treasurer.

LOUISVILLE, KY.—At the annual meeting of the Louisville Lighting Company the following named officers were elected: F. M. Sackett, president; Harry Bishop, vice-president; T. B. Wilson, secretary and treasurer.

BALTIMORE, MD.—At the annual meeting of the United Railways & Electric Company the retiring board of directors was re-elected.

MERIDIAN, MISS.—At the annual meeting of the Meridian Light & Railway Company the following named officers were elected: A. J. Patterson, president; W. H. Armbrecht, first vice-president; J. A. Gibson, second vice-president; C. S. W. Price, Jr., secretary and treasurer, and A. B. Patterson, general manager.

MEDFORD, N. D.—At the annual meeting of the Medford Mutual Telephone Company the following named officers were elected: Daniel McKeith, president; A. H. Kellogg, vice-president; M. B. Kellogg, secretary, and William Falter, treasurer.

JEFFERSON, CITY, TENN.—The Citizens' Telephone Company, recently organized, has elected the following named officers: J. V. Cline, president and general manager: R. M. Bales, vice-president; G. A. Moody, secretary and treasurer.

CAMERON, WIS.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: O. L. Olsen, president; S. E. Severson, vice-president; M. A. Worman, secretary, and J. O. Juve, treasurer.

DALLAS, WIS.—At the annual meeting of the Dallas Farmers' Telephone Company the following named officers were elected: John Borgen, president; M. Casper, vice-president; W. Franzen, secretary, and H. Klemmo, treasurer.

New Incorporations.

BAY MINETTE, ALA.—Articles of incorporation have been filed for the City Ice & Light Company with a capital stock of $20,000. E. G. Nelson is president.

PINE BLUFF, ARK.—The Pine Bluff-Little Rock Transit Company has been organized for the purpose of building an electric railway from Pine Bluff to Little Rock. The officers of the company are: W. F. Campbell, president; B. F. Foreman, of Texarkana, vice-president; Mrs. F. A. Gibson, of Redfield, secretary and treasurer.

WINSLOW, ARK.—The Winslow Telephone & Electric Light Company has filed articles of incorporation, with a capital stock of $1,000. The directors are E. E. Miller, J. H. Smith, J. F. Black, G. A. Winn, V. M. Dunlap and others.

GLENDORA, CAL.—The Glendora Light & Power Company has been formed here, with a capital stock of $20,000, by J. A. Jones, president; H. G. Baker, vice-president, and C. S. Whitcomb, secretary and treasurer. The company will install a plant within 60 days.

GONZALES, CAL.—The Gonzales Electric Company has been incorporated, with a capital stock of $75,000, by H. M. Pitman, of Calistoga; M. C. Clark, of Gonzales, and E. Johnson, of Oakland.

LOS ANGELES, CAL.—The Standard Gas & Electric Company has been incorporated, with a capital stock of $50,000. The directors are: W. S. Cramp, Horace Slater and R. J. Dunn, all of Redlands.

MAYBELL, COL.—The Maybell Telephone Company has been incorporated, with a capital stock of $50,000, by W. T. Stillings, T. C. Smith, B. A. Arbogast and others.

DAHLONEGA, GA.—The Mill Creek Water Power & Mining Company has been chartered with a capital stock of $100,000 by H. W. Gilbert and others. The purpose of the company is to develop water power to generate electricity.

AURORA, ILL.—The Elgin, Woodstock & Lake Geneva Railroad Company has been chartered with a capital stock of $25,000 to construct a railway from Elgin to Raymond. The incorporators are: G. W. Youngs, F. R. Spear and G. H. Bryant.

LORAINE, ILL.—The Woodville Telephone Company has been incorporated with a capital stock of $900 by E. P. Poling, John Nelson and Nathan Hopson.

SHANNON, ILL.—The Shannon Telephone Company has been incorporated by G. W. Bolinger, Henry Veitmeier and C. I. Byington.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis, Cloverdale & Terre Haute Traction Company by E. M. Bowman, H. F. Metze and Denis C. Rutherford. The company proposes to construct and operate street and interurban electric railways in and connecting Indianapolis and Terre Haute and intervening cities, and also to furnish electricity for lamps, heat and motors. The company is capitalized at $10,000.

TONGANOXIE, KAN.—The telephone systems of Tonganoxie, Basheor and Linwood have been consolidated under the name of the Suburban Telephone Company, for which a charter has been secured, and the following directors elected: W. C. Allen, E. H. Cox, A. A. Jones, J. W. Kemler and F. B. MacKinnon. The company contemplates the construction of new lines in the near future.

FRANKFORT, KY.—Articles of incorporation have been filed for the Concord & Pleasant Hill Telephone Company, of Russell County, with a capital stock of $300.

PORTLAND, MAINE.—The Arizona Power Company has been incorporated, with a capital stock of $4,000,000, for the purpose of furnishing electricity and other power. J. E. Mantor is president and I. A. Sutherland treasurer, both of Portland.

PORTLAND, MAINE.—The Santo Domingo Water, Light, Heat & Power Company has filed articles of incorporation with a capital stock of $1,400,000. A. P. Chickering, of North Andover, Mass., is president of the company.

PORTLAND, MAINE.—Articles of incorporation have been filed for the Upper Iowa Light & Power Company with a capital stock of $305,000. The company proposes to operate light and heating plants. J. E. Manter is president, and C. E. Eaton is treasurer, both of Portland.

BEMIDJI, MINN.—The Plantagenet Telephone Company has been organized by A. H. Jester and others, and plans are being made for the construction of a telephone line from Bemidji to Lake Plantagenet.

CARLISLE, MINN.—The Carlisle Telephone Company has been incorporated, with a capital stock of $2,500, by John J. Tomhave, Jacob J. Tomhave, C. R. Wright and Ferdinand Pergande.

LOWRY, MINN.—The Lowry Telephone Company has been chartered, with a capital stock of $16,000. Peter Engebretson is president of the company.

OSTRANDER, MINN.—The Ostrander-Cherry Grove Co-operative Telephone Company has filed articles of incorporation. The following-named officers have been elected: H. E. Olsen, president; Herman Aarness, treasurer.

COLUMBUS, MONT.—Articles of incorporation have been filed for the Columbus Electric Light & Water Company with a capital stock of $20,000 by James Craig and others.

OKLAHOMA CITY, OKLA.—The Oklahoma-Shawnee Interurban Company has been granted a charter by the Secretary of State with a capital stock of $300,000. The incorporators are: H. M. Wyatt, A. M. Spencer, Stephen Brown, Joseph Brown, and J. A. Stephenson, all of Oklahoma City.

GOLDFIELD, NEV.—The Rawhide Water Power & Milling Company has been incorporated here, with a capital stock of $300,000, by W. Stouford, W. B. Kolman and others.

NEWARK, N. J.—The Federal Electric Company has filed articles of incorporation, with a capital stock of $125,000, for the purpose of generating electricity for heating, lamps, motors, etc. The incorporators are C. Weigand, H. Weigand and J. N. Becker, all of Newark.

GAGE, N. Y.—Articles of incorporation have been filed for the Benton Telephone Company, with a capital stock of $1,000, by J. K. Turner, W. D. Beattie and Charles Legg, of Gage, N. Y.

PITTSTOWN, N. Y.—Articles of incorporation have been filed for the Pittstown Telephone Company for the purpose of constructing a telephone line from Pittstown to Brunswick and intervening towns. The capital stock of the company is placed at $500 and the directors are: E. E. Rayner, president; S. W. Humphrey, Paul Sherman, E. L. Dutton, W. B. Sherman, of Pittstown; Edward Everett Welling and T. Brownell, of Tomhannock.

SOCORCO, N. M.—Articles of incorporation have been filed for the Socorco Electric Company to construct, acquire and operate electric plants to furnish electricity for lamps and motors. The capital stock is $30,000. Emmett A. Drake, Morris Loewenstein, A. C. Abeytia and J. G. Fitch are the directors.

WEST BERNE, N. Y.—The West Berne Telephone Company has been chartered, with a capital stock of $2,000. The directors are A. J. Haverly, G. D. Shultes, I. B. Schoonmaker, W. H. Williamson and others.

WILLIAMSVILLE, N. Y.—Articles of incorporation have been filed for the Williamsville Electric Light & Power Company, with a capital stock of $35,000, by Oscar A. Simon, of Williamsville; James D. Ferris, Arthur B. Jenkins, Louis E. R. French and Nelson S. Hallett, of Buffalo.

WILSON, N. Y.—Application has been made for the incorporation of the Wilson Telephone Company, which is to connect with the lines of the Home Telephone Company.

FARGO, N. D.—The Oakport & Kragnes Telephone Company has been organized. A. G. Kassenborg is president of the company.

ELYRIA, OHIO.—The Home Telephone Company has been organized. The capital stock of the company is placed at $10,000.

WARREN, OHIO.—The Hydro-Electric Company has been organized here and will be incorporated, with a capital stock of $100,000, by C. M. Wilkins, O. D. Morgan, D. E. Hoover and C. R. Siegfried, of this city, and Henry Herbert, of Newton Falls. The company proposes to develop water power for the purpose of generating electricity for lamps, motors and electric railways.

WILMINGTON, OHIO.—Articles of incorporation have been filed for the Cincinnati, Wilmington & Xenia Traction Company, with a capital stock of $50,000, by K. H. Grantham and others.

CALUMET, OKLA.—Articles of incorporation have been filed for the Mistletoe Telephone Company, with a capital stock of $800, by Eugene Schaeffer, Elmon Denney, W. S. Meyers, S. K. Booth and M. Vandiver.

FLORENCE, OKLA.—The Kent Rural Telephone Company has filed articles of incorporation, with a capital stock of $850. The incorporators are J. King, A. V. Ray and others.

MUTUAL, OKLA.—The Canadian Valley Railway Company has been incorporated, with a capital stock of $2,000,000, to build an electric railway from Mutual to Oklahoma.

STIDHAM, OKLA.—The Oklahoma Telephone Company has been organized, with a capital stock of $1,000, by V. K. Hill, F. L. Smith and others.

STUART, OKLA.—The A. C. McNally & Brothers Telephone Company has been chartered, with a capital stock of $500, and the following directors: A. C. McNally, W. H. McNally and M. F. McNally, all of Stuart.

LEBANON, PA.—The Bunker Hill Electric Light & Power Company has been chartered, with a capital stock of $5,000. The directors are: Daniel Weaver, treasurer; John S. Weaver, A. Gingrich, Monroe Gingrich, all of Lebanon, and Elias B. Gingrich, of Jonestown.

AMBRIDGE, PA.—A charter has been granted by the Secretary of State to the Ambridge Borough Light, Heat & Power Company with a capital stock of $5,000. The incorporators are: C. R. Wilson, treasurer; T. K. Bevington, George N. Martin, all of Pittsburg, Pa.

WARRINGTON, PA.—The Warrington Mutual Telephone Company has been organized to install a telephone system in the town.

ARMOUR, S. D.—The Armour Telephone Company has been incorporated, with a capital stock of $25,000.

BISHOPVILLE, S. C.—The Bishopville Telephone Company has been chartered, with a capital stock of $5,000. The following-named officers have been elected: Thomas G. McLeod, president; Robert Shelor, secretary and treasurer.

FAIRVIEW, S. D.—Articles of incorporation have been filed for the Fairview Center Telephone Company and the following officers elected: E. O. Swenson, president; Stein Larsgaard, vice-president; Carl Ammson, secretary, and Miner Sorum, treasurer.

GORDONSVILLE, TENN.—A local telephone company has been organized to build a telephone line to Hickman, a distance of two and one-half miles, to connect with the exchange at that place. The officers are: W. A. Davis, president; J. D. Rives, secretary, and J. F. Gwaitney, treasurer.

AMARILLO, TEX.—The Glenwood Electric Park Company has been incorporated with a capital stock of $20,000 by H. A. Nobles, J. C. Paul, John G. Hartman and others.

TRENT, WASH.—Articles of incorporation have been filed for the Trent Water Power by J. A. Narup, M. G. Narup and R. J. Benson. The company proposes to furnish water for irrigation purposes and to build power plants. The capital stock of the company is placed at $10,000.

TACOMA, WASH.—The Bremerton-Charleston Light & Fuel Company has been incorporated, with a capital stock of $70,000, by F. C. Brewer and T. L. Stiles.

MYRA, W. VA.—The Lincoln County Telephone Company has been incorporated, with a capital stock of $25,000, by T. B. Snodgrass, W. E. Tabor, W. F. Black, J. E. Morgan, David Miller, of Myra; A. W. Stone and A. F. Kranklin, of Sheridan, and others.

MAY, WIS.—An Independent Telephone Company has been organized in this city. The officers are: Peter Witherby, president, and O. Engberg, treasurer.

PIGEON FALLS, WIS.—The Pigeon Valley Farmers' Telephone Company has been incorporated, with a capital stock of $10,000, by S. D. Simrod, J. J. Staff, A. N. Anderson and others.

RHIENLANDER, WIS.—The Langlade Power Company has been organized by E. A. Forbes, C. A. Wixson and A. W. Shelton, of Rhienlander, and E. T. Sherry, of Milwaukee, for the purpose of developing water power on the Wolf River, 24 miles from Antigo. It is proposed to develop 4000 hp and to build a transmission line to Antigo to supply electricity in that city for motors.

LUTHER, WYO.—Articles of incorporation have been filed for the Pioneer Telephone Company for the purpose of building telephone lines between Hillsdale, Luther, Egbert, Pine Bluffs and Carpenter. The officers of the company are: George N. Brady, president and general manager; M. J. Wragg, vice-president; Henry D. Colburn, secretary, and S. D. Schultz, treasurer.

Legal.

RECEIVER FOR TELEPHONE COMPANY.—Vice-Chancellor Howell, sitting in Newark, N. J., has appointed Frederick T. Johnson, of Newark, receiver for the United States Independent Telephone Company, of Rochester, N. Y., recently declared insolvent.

RECEIVER FOR GAS AND ELECTRIC COMPANY.—F. L. Hay has been appointed receiver for the People's Gas & Electric Company, of Defiance, Ohio. The application for a receiver was made by the Guardian Savings & Trust Company, of Cleveland; the Anderson Coal Company and the Lorain Coal & Dock Company.

RECEIVER FOR CONSUMERS' ELECTRIC COMPANY.—Samuel Insull, president of the Commonwealth Edison Company, of Chicago, Ill., has been appointed receiver of the Consumers' Electric Company, of New Orleans, La., with a capital stock, bonds and other obligations aggregating about $2,500,000. The receivership was asked for by the National Conduit Cable Company, of New York, N. Y., holder of $2,080,000 first mortgage bonds of the company. The petition for the receivership states that the company had defaulted in payment of interest due on bonds.

FEDERAL DISTRICT MAKES INJUNCTION AGAINST DETROIT ORDINANCE PERMANENT.—Judge Swan, of the United States District Court, April 6 made permanent an injunction restraining the city of Detroit from enforcing the Hally ordinance, which would have compelled the United Railway to operate its cars on streets where franchise right have expired under regulations which provide for the sale of five tickets for 15 cents, universal transfers, the payment of taxes on an ad valorem basis and caring for the paving between tracks and the foundations under the rails. The city will appeal.

DUTY OF ELECTRIC LIGHT COMPANY TO PERSON NOT IN ITS EMPLOY.—An electric light company owes a duty to exercise a proper degree of care to prevent a dangerous current from entering a house taking its service and endangering any one who may rightfully be upon the premises; and for an injury received the company is directly responsible, although the owner of the house may also own the wires therein. In a case involving this proposition of law a workman engaged in installing a furnace was killed by contact with the lighting fixtures. It appeared that the transformer used to reduce the current before it entered the building had become out of order, and that although defendant had been notified of the fact some hours before, it had done nothing to remove the danger. The deceased was told by a fellow workman that an employee of the owner had received a shock when turning on a light, that the company had been notified, and had sent an expert who had left some two or three hours before. There was evidence tending to show that deceased attempted to turn on the light in order to see better in finding his tools. It was held that the question of his contributory negligence was properly left to the jury, and that their verdict against the company would not be disturbed, it not appearing but that the workman might well have supposed that the trouble with the lights was trifling, and had been fully remedied by the defendant's expert. Union Light, Heat & Power Co. v. Arnston, United States Circuit court of Appeals, 157 Fed. Rep. 540.

Personal.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, is leaving with Mrs. Ward for Lisbon, Portugal, to attend the forthcoming submarine cable conference, which apparently will be held in spite of the recent political troubles there.

MR. JOHN B. OLMSTEAD, of Buffalo, N. Y., has been appointed by Governor Hughes a member of the Public Service Commission in the Second District in place of Mr. Charles H. Keep, who recently resigned to accept the presidency of the Knickerbocker Trust Company, of New York, N. Y.

MR. GEORGE L. COLLINS, formerly general manager of the Consolidated Gas & Electric Company, of Batavia, N. Y., has been appointed manager of the Ontario Light & Traction Company and the Canandaigua Gas Light Company, of Canandaigua, N. Y., and will assume management of the properties May 1.

MR. W. H. HORTON, who recently resigned as superintendent of the Rutland Railway, Light & Power Company, of Rutland, Vt., has accepted a position as assistant superintendent of the Atlantic, Gulf & Pacific Construction Company, of New York, N. Y., which now has charge of construction work on the canal at Whitehall, N. Y.

MR. WILLIAM H. DONNER has been elected vice-president of the Westinghouse Machine Company, of Pittsburg, Pa., which was taken out of the receivers' hands a few days ago. A circular has been issued by President George Westinghouse announcing Mr. Donner's election and stating that the latter will have direct charge of all the company's activities.

MR. VICTOR L. SCOTT, of San Antonio, Tex., who brought out some very effective literature not long ago showing electric light managers how to meet gasoline competition has just recovered from a severe illness due to overwork. He is proposing to seek a change of climate, and will probably engage in some commercial department of the work in the Northwest.

MR. E. B. DOEN, superintendent of the Syracuse Lighting Company, of Syracuse, has resigned his position to go into the electrical contracting business. Mr. Doen has been in the employ of the company for over 21 years. He intends to open a place of business in this city in the near future. Mr. M. G. Kennedy, who was formerly assistant inspector of plants, succeeds Mr. Doen.

MR. E. E. KELLER, for over 20 years connected with the Westinghouse interests and for 14 years vice-president of the Westinghouse Machine Co., having completed his duties as receiver and general manager, severed his connection with the management of that company on the first of this month. Mr. Keller will take a much needed rest and will then devote most of his time to several personal interests.

MR. S. E. WOLFF, vice-president and general manager of the Saginaw Valley Traction Company, which controls all the gas, electric and traction companies of Saginaw and Bay City, Mich., has resigned to accept a more responsible position with Hodenpyl, Walbridge & Company, of New York, N. Y., who own the local corporations. Mr. Wolff will be succeeded by Mr. John F. Collins, at present general superintendent of the Toledo Railway & Light Company, of Toledo, Ohio.

Obituary.

MR. ALBERT K. HISCOCK died at his home in Syracuse, N. Y., April 7. He was 47 years old and was vice-president of the Trust & Deposit Company, of Onondaga, and treasurer of the Auburn & Syracuse; Rochester, Syracuse & Eastern; Syracuse, Lake Shore & Northern, and Syracuse & South Bay railways, and a managing director in the Auburn & Northern Company; Oswego Traction Company; Monroe County Belt Line, and Skaneateles Lake Transportation Company. He was also a director of the construction companies building the electric railway lines.

Trade Publications.

OUTLETS AND BUSHINGS, which correspond to the National Code Standard, are listed in a bulletin of the Steel City Electric Company, Pittsburg, Pa.

TIME RECORDERS.—The Calculagraph Company, 9 Maiden Lane, New York, has issued an interesting article by Mr. R. W. Higgins on cost accounting in factories. This article contains many hints of value to those engaged in estimating cost of labor in factory products.

ELECTRICAL SPECIALTIES are listed, illustrated and briefly described in the latest catalogue of the Tregoning Electric Manufacturing Company, Cleveland, Ohio. The catalogue covers porcelain receptacles, rosettes, attachment plugs and "lobster-claw" battery connections.

LIFTING MAGNETS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued an exceptionally well-illustrated catalogue describing various types of lifting magnets and their uses. The last three pages of the catalogue contain a partial list of users of the magnets.

INCANDESCENT LAMPS.—Publication No. 575, of Veritys, Ltd., Aston, Birmingham, England, is devoted to the "Atonlite" system of illumination. The apparatus consists of a metal trough, with sides containing panels of white opal reflector glass, in front of which is a straight-filament incandescent lamp.

COPPER HISTORY.—The Wire & Telephone Company of America, Rome, N. Y., has recently issued a "Copper History" folder giving the monthly and yearly average selling prices of copper since 1883. A copy will be forwarded to anyone for the asking.

PENNSYLVANIA TUNNELS.—The United Engineering and Contracting Company, 32 East Thirty-third Street, New York, has issued a well prepared illustrated description of the main features of the engineering work of the Manhattan crosstown tunnels of the Pennsylvania Railroad, now under construction.

AMMONIA RECOVERY GAS PLANTS are fully described and attractively illustrated in a bulletin issued by Crossley Bros., Ltd., 10 S. Bride Street, Ludgate Hill, E. C., London, England. It is stated that ammonia recovery apparatus can be used economically with gas plants burning at least 100 tons of coal per week.

WORCESTER POLYTECHNIC INSTITUTE.—The thirty-eighth annual catalogue of the W. P. I. states that the total present student registration is 465; 146 of these students are freshmen. Of the remaining students, 101 are in the electrical engineering department. The total number of students registered to date is 2337, 1195 of whom have graduated.

DIRECT-CURRENT MOTORS rated at from 10-hp to 105-hp of the open type, and from 7.5-hp to 50-hp of the enclosed type, are listed and described in Bulletin No. 224, of the Sprague Electric Company, 527 West Thirty-fourth Street, New York. Bulletin No. 310 deals with motors for operating ventilating fans and blowers.

MOTOR-DRIVEN AIR-PUMPS and various other medical devices are described in a well-illustrated catalogue recently issued by the Globe Manufacturing Company, Battle Creek, Mich. A folder of the same company is devoted to a variable ratio alternating-current transformer for use with electric cautery knives and diagnostic lamps.

CENTRIFUGAL AIR COMPRESSORS rated at from 750 to 10,000 cu. ft. of free air per minute at pressures ranging from .88 to 4.0 lb. per square inch are described in Bulletin No. 4564 of the General Electric Company. Low maintenance and repair, high-efficiency in operation and minimum required floor area are claimed for these compressors.

STANDARD WIRE SYMBOLS.—The Allis-Chalmers Company has prepared, with the permission of the National Electrical Contractors' Association, a reprint of the standard wiring symbols which have been adopted by that association for use in wiring specifications. A copy of this bulletin will be sent to anyone interested, upon receipt of a request.

STEAM GAGES AND VALVES, indicators and kindred appliances for governing, indicating, measuring, recording and controlling steam, water, air, gas, oil or ammonia are thoroughly covered in a handsome 247-page catalogue bound in cloth, recently issued by the American Steam Gauge & Valve Manufacturing Company, 208 Camden Street, Boston, Mass.

Unclassified Items.

QUINCY, MANCHESTER, SARGENT CO., of Plainfield, N. J., will discontinue the manufacture of the line of pneumatic compression riveters it acquired at the time of purchasing the Pedrick & Ayer business, and has disposed of this entire line to the Hanna Engineering Company, of Chicago. This measure was decided upon in order that all effort may be concentrated on the company's lines of metal sawing machines, cranes, hoists and car steps.

THE CROCKER-WHEELER COMPANY, on April 24, will move across the street to new quarters at 32 Cortland Street in the Cortlandt Building, Hudson Terminal. The new location is of special convenience to the Crocker-Wheeler Company, as it brings its New York Office into closer touch than ever with the works and main office at Ampere, N. J.

CHICAGO, ILL.—At the annual meeting of the Chicago & Milwaukee Electric Railway Company the following named officers were elected: A. C. Frost, president; H. C. Osborn, of Toronto, Ont., vice-president; Pierce G. Beach, secretary, and W. O. Kilman, treasurer.

INDIANAPOLIS, IND.—At the annual meeting of the Indianapolis Street Railway Company the following officers were elected: George Brown, president; J. A. Lemcke, first vice-president; James S. Neff, of Philadelphia, Pa., second vice-president; Henry Jameson, secretary and treasurer.

RICHMOND, VA.—Plans are being considered for the construction of an electric railway from Fulton to Warwick Park, located five miles below Richmond. It is reported that the railway will be constructed by the South Richmond Railway Company, which was incorporated in 1902. The cost of the road is estimated at $100,000, work on which will commence as soon as the right of way is secured. Tentative arrangements have been made with the Virginia Passenger & Power Company for electrical energy to operate the road, which will be supplied from the Twelfth Street power house. Col. C. P. E. Burgwyn is engineer of the proposed road.

CALUMET, MICH.—Plans are being considered by the Calumet & Lac la Belle Traction & Power Company to construct an extension of its railway from Calumet across the Centennial Heights to the shore of Lake Superior.

GRAFTON, ILL.—Plans are being prepared for the construction of an electric light plant and water works system, the cost of which is

estimated at about $22,000. W. S. Merkel, 1106 Pine Street, St. Louis, Mo., is the engineer.

MARQUETTE, MICH.—It is stated that the Marquette County Gas & Electric Company is planning to extend its electric railway from Negaunee to Marquette, a distance of 12 miles.

CLARKSBURG, W. VA.—Surveys are being made for the extension of the Fairmont & Clarksburg Traction Company's system from Grasselli to Bridgeport.

AMERICUS, GA.—The Americus Railway & Light Company has awarded a contract to Kite & Wilson, of Columbus, for the construction of a power house.

ST. VINCENT, MINN.—It is proposed to erect a farmers' telephone system in this vicinity at a cost of about $10,000. T. M. George is interested in the project.

COLORADO SPRINGS, COL.—Arrangements are being made by the Central Colorado Power Company to resume operations on all outside work at an early date. The company temporarily suspended work last fall, owing to the closing of the Knickerbocker Trust Company, of New York, N. Y.

NEW HAVEN, CONN.—At the annual meeting of the Connecticut Railway & Lighting Company the following named officers were elected: A. M. Young, of Branford, president; R. A. C. Smith, of New York, N. Y., first vice-president; Randal Morgan, of Philadelphia, Pa., second vice-president; W. S. Douthirt, secretary, and Lewis Lillie, of Philadelphia, Pa., treasurer.

FORT GIBSON, OKLA.—The Grand River Light & Power Company, recently incorporated, has placed contracts for the construction of its plant, to cost about $15,000.

TOPEKA, KAN.—The citizens on April 7 voted to issue bonds not to exceed $65,000 for repairing the municipal electric light system.

SPENCER, IND.—Articles of incorporation have been filed for the Spencer Light, Power, Heat & Water Company with a capital of $75,000, by Laurent Lowenberg, of Cincinnati, Ohio; Carl J. Keefer and others.

MOBILE, ALA.—John T. Cochrane, 614 City Bank Building, Mobile, would like to receive prices on dynamos and electrical outfit for plant to furnish electricy for 300, 500 and 750 lamps respectively.

Business Notes.

THE GREGORY ELECTRIC COMPANY, Chicago, reports a marked increase in its business during the last six weeks and that at present its trade is as large as at any time during the boom year of 1907.

MR. HORACE WINTHROP SCANDLIN, formerly assistant advertising manager of the Edison Electric Illuminating Company, of Brooklyn, is with the Siegfried Advertising Agency, of New York City.

THE FLEMING-HARRISBURG engines sold by Mr. A. M. Morse, manager of the Chicago office of that concern, will be found operating the electric plants of the Auditorium Hotel and Annex and the Fine Arts Building, where the National Electric Light Convention meets in May. A large number of these engines can be found in isolated plant service elsewhere in Chicago.

FLAMING ARC LAMPS FOR TOWER CLOCKS.—The Excello Arc Lamp Company, 24 East Twenty-first Street, New York, makes a specialty of flaming arc lamps for indoor use. A rather novel application of such lamps is found in the tower of the Lackawanna Terminal at Hoboken, N. J. where two lamps are connected to the alternating-current circuit for illuminating the clock dials at night. One of the chief requirements is reliability of operation with a minimum of attention. To obtain this incandescent lamps were first installed, but owing to the thickness and quality of glass used and the height of the tower the number on the dial could not be seen. Excello flaming arc lamps were then tried with success.

MAC GOVERN, ARCHER & CO. have just made arrangements to move into their new warehouse and shop on Carbon Place, near West Side Avenue, Jersey City. This is a most convenient and high grade constructed factory building with adjoining lots and outbuildings covering approximately two acres of land. The main factory building has an area of 10,000 sq. ft. on one floor, which is of heavy concrete suitable for the storage of heavy machinery. The entire property has a direct siding off the C. R. R .of N. J., which makes it most convenient for the receiving and shipping of heavy apparatus, such as the company handles largely. One of the attractions of the factory is its accessibility, it being within 20 minutes' time from New York City. This company announces that it is about to move into commodious quarters in the Engineering Building, 114 Liberty Street, in the offices formerly occupied by the International Steam Pump Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 7, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

883,756. HEAT RADIATOR FOR HYDROCARBON AND OTHER HEAT MOTORS; Klaus J. Steiner, Pittsburg, Pa. App. filed Dec. 28, 1906. A process of making the radiator of automobiles by electrolytic process, so as to provide a copper lining which resists the solvent effects of the hot water.

883,760. SYSTEM OF DISTRIBUTION; Lewis L. Tatum, Norwood, Ohio. App. filed Feb. 19, 1906. Relates to multiple voltage systems of distribution in which balancers are employed for supplying current to the branches of the system which carry the heaviest currents, to maintain the voltages of the branches at their proper predetermined values.

883,777. CLUSTER LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed April 14, 1904. A cluster socket of the type having a porcelain base from which projects downward a pair of concentric hemispherical cups and which support the threaded shells. The center contacts are supported directly on the base.

883,822. DYNAMO ELECTRIC MACHINERY; Charles Algernon Parsons, Newcastle-upon-Tyne, England. App. filed April 23, 1906. An armature winding having a wrapping of tape containing strips of metal of high thermal-conductivity interposed between the separate conductors of the coils.

883,823. INSULATOR SUPPORT; Charles L. Peirce, Jr., Elkhart, Ind. App. filed Aug. 19, 1907. Makes use of a U-shaped strip having legs or prongs arcuate in transverse section and fitting closely around a central supporting pin.

883,829. AUTOMATIC SIGNALING MECHANISM; Josef Reuter, of Rochester, N. Y. App. April 15, 1907. A signal transmitter having a clock-driven gear train including a plurality of cam cylinders which operate to transmit a particular sequence of signals corresponding, for example, to the box number of a fire alarm.

883,701. SWITCHING DEVICE; James A. Duffy and Oscar Irwin, Pittsburg, Pa. App. filed Jan. 19, 1904. An electrical track switch of the type in which the motorman may cause a selective operation by the action of his controller. Has semaphore signal features to indicate the positions of the switch point.

883,723. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed July 12, 1907. Relates to telegraph and telephone signaling in proximity to a power circuit having inductance effects. Makes use of a special return conductor for the power circuit connected through condensers with the telephone wires so as to neutralize the induction effects therein.

883,724. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed July 18, 1907. Relates to modifications of the above.

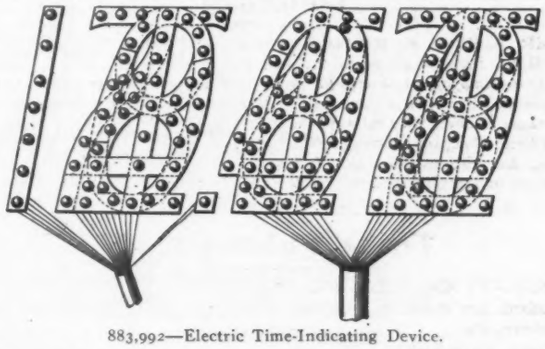
883,725. WORKING OF ELECTRIC VAPOR LAMPS; Richard Küch, Hanau, Germany. App. filed Dec. 7, 1905. The method of working gas or vapor electric lamps having mercury electrodes which consists in applying to said electrodes an electric potential of not less than twenty-five volts per centimeter of the length of column of light.

883,846. ELECTRICAL MULTIPLE INFLUENCE OR CONDENSER MACHINE; Heinrich Wommelsdorf, Charlottenburg, Germany. App. filed Feb. 28, 1905. A Wimshurst static machine in which the plates or segments are imbedded in the insulating disk so as to prevent sparking across. The disks are employed in series and the segments are connected by metallic pins extending throughout the entire series.

883,919. REACTIVE COIL; Charles P. Steinmetz, Schenectady, N. Y. App. filed May 19, 1906. The combination with a vapor electric device, of reactive means connected thereto, and means for retarding the drop of current in said reactive means.

883,924. ARC LAMP ELECTRODE; William S. Weedon, Schenectady, N. Y. App. filed April 21, 1903. An electrode consisting of titanium carbid incased in a copper sheath.

883,943. REVERSE CURRENT CIRCUIT BREAKER; Charles E. Eveleth, Schenectady, N. Y. App. filed May 25, 1904. Relates to circuit breakers, and more particularly to means for automatically opening the



883,992—Electric Time-Indicating Device.

breaker when the direction of the current flow through the main circuit is reversed. Provides means operated by the field adjacent to the circuit breaker contact for controlling the action of a tripping mechanism.

883,944. ELECTRIC LIGHTING; Walter C. Fish, Lynn, Mass. App. filed Dec. 8, 1904. A means for supplying the red rays which are desirable in mercury vapor lamp illumination. For this purpose the mercury vapor lamps shine upwardly against an opalescent reflector behind which is provided a bank of incandescent lamps, the rays from the two sources being thereby blended.

883,956. MOTOR STARTER; Albert J. Horton, White Plains, N. Y. App. filed June 13, 1906. Compound motor starter having means whereby it is impossible for the operator to leave the starting lever in an intermediate position and weaken the field circuit with the resistance still included in the armature circuit.

883,961. ELECTROMETALLURGICAL PROCESS FOR EXTRACTING COPPER FROM ITS ORES; Lucien Jumau, Paris, France. App. filed Jan. 19, 1907. The herein-described electrolyptic process for obtaining pure copper from its ores, which consists in lixiviating the ores with an ammoniacal solution, precipitating the copper from said solution in the form of a precipitate containing cuprous sulfite, dissolving

said cuprous sulfite in an ammoniacal solution, and in subjecting said last solution to electrolyptic action in the presence of carbonate of ammonia.

883,964. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Harry N. Latey, New York, N. Y. App. filed Jan. 19, 1904. A signaling system actuated automatically whenever the potential in a section shall have fallen to a predetermined point, thereby warning the operators of trains approaching the section of its condition.

883,992. ELECTRIC TIME-INDICATING DEVICE; William F. Wentz, New York, N. Y. App. filed Dec. 22, 1904. An electric sign and mechanism for operating the same, particularly adapted to display time indications in numerals denominating hours and minutes. The composite figure formation is especially adapted to this particular purpose, consideration being given to the fact that certain figures never occur in in the tens of the minute numerals or in the tens of the hour numerals. The circuit controlling mechanism includes an hour drum and a minute drum having pins which engage spring blades to move them into circuit closing relation.

884,002. CONTROLLER FOR ELECTRIC MOTORS; Thomas E. Barnum and Henry H. Cutler, Milwaukee, Wis. App. filed June 18, 1902. A motor for controlling electric elevators having means to prevent the admission of current to the motor until all of the starting resistance is in circuit, and to prevent operating the motor for any length of time with any of the resistance in the circuit of the motor.

884,007. TRAIN CONTROL FOR ELECTRIC ACCUMULATOR LOCOMOTIVES; Otto Böhm, Berlin, Germany. App. filed Aug. 6, 1907. A control mechanism for accumulator locomotives in which the control of any number of locomotives coupled together can be effected from a single controller. Each car has a motor and a battery, and the controllers of locomotives which have no drivers are all set to full speed.

884,015. ELECTROLYTIC CELL; Albert S. Gray, Chicago, Ill. App. filed March 15, 1906. Electrolytic cell for the treatment of ores, adapted to provide for the rapid escape of gases that would otherwise prevent the proper passage of the current through the cell.

884,018. INCUBATOR ALARM; Fremont R. Harris, Kenmare, N. D. App. filed May 22, 1907. A form of thermostat having a vane poised above the chimney of the lamp and operating to close an alarm circuit when it is no longer held elevated.

884,021. APPARATUS FOR MAKING COPPER; Marcel A. Jullien and Emile L. Dessolle, Levallois-perret, France. App. filed April 4, 1907. An apparatus of the class described comprising, in combination a receptacle for the electrolytic bath, an actuated member on which the metal is deposited, a carriage movable with respect to said member, a polisher pivotally mounted on said carriage and bodily removable abreast of said member, and means mounted on said carriage for imparting movement of the polisher about its pivotal mounting.

884,028. ACCUMULATOR PLATE; Michail Margulis, Odessa, Russia. App. filed June 7, 1907. A form of accumulator plate designed to prevent distortions during charging and discharging. Makes use of a frame with depending corrugated lead strips, which are kept in alignment by transversely extending rods of hard lead.

884,047. AUTOMATIC ALARM SYSTEM; John E. Shepherd, Chicago, Ill. App. filed Jan. 13, 1908. Automatic alarm system adapted to supervise the heat conditions in an area to be protected, and to respond by the initiation of an alarm to sudden rises in temperature.

884,049. PNEUMATIC HOLDER FOR COMMUTATOR BRUSHES; Charles William Speirs, Battersea, London, England. App. filed Feb. 23, 1907. A holder for a commutator brush having a piston in communication with a source of air pressure. The piston has a rubber diaphragm of peculiar construction, to avoid packing rings.

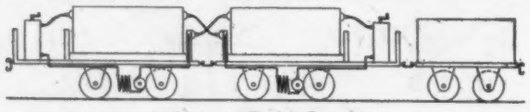
884,066. AUTOMATIC ALTERNATING CURRENT CONTACT APPARATUS; Charles Eugen Lancelot Brown, of Baden, Switzerland. App. filed Nov. 7, 1903. Has an electro-magnet and a non-magnetic rotatable disk from which depend a weighted cord. In case the disk revolves, the cord drops and closes an electric circuit.

884,070. SPACE TELEGRAPHY; Sewall Cabot, Brookline, Mass. App. filed Nov. 13, 1906. In a space telegraph system, a sonorous circuit, a normally closed power circuit, a normally open intermediate circuit connecting said sonorous circuit with said power circuit, and means for controlling said normally open circuit, and means comprising a switch having a plurality of series-contacts.

884,071. SPACE TELEGRAPH; Sewall Cabot, Brookline, Mass. App. filed Dec. 31, 1906. In a system of space telegraphy, an elevated conductor system comprising a laterally extending conducting surface having its inner portion cut away and its perimeter large compared with its distance above the earth.

884,074. ATTACHMENT FOR TROLLEY POLE CLAMPS; Curtis W. Clark and Charles E. Yingling, of Eaton, Ind. App. filed Jan. 13, 1906. Has a pair of clamping plates adapted to surround a trolley pole, and a supplemental plate operatively connected to said clamping plates and provided with means for producing a clamping movement between said two plates.

884,075. ELECTRODEPOSITION OF IRON; Sherard O. Cowper-Coles, London, England. App. filed Sept. 16, 1907. The process of



884,007—Train Control.

obtaining the electro deposition of iron, which consists in forming an electrolyte from a substance containing iron, and in maintaining the electrolyte charged with iron, substantially as described.

884,076. SPACE TELEGRAPHY; Ernest R. Cram, Cambridge, Mass. App. filed May 7, 1906. In a space telegraph receiving system, an elevated receiving conductor system; a resonant receiving circuit attuned to the frequency of the waves the energy of which is to be received; and a series of circuits, interposed between said elevated receiving conductor system and said resonant receiving circuit and each having a pronounced natural rate of vibration different from that of said resonant receiving circuit, the first circuit of said series being tightly coupled to said elevated conductor system.

884,102. ELECTRIC LAMP SOCKET; Mortimer Norden, New York, N. Y. App. filed March 4, 1907. An incandescent electric socket for use with electric signs for decorative purposes. Has a porcelain block adapted to be screwed on the rear of a sheet metal plate having a socket portion in alignment with an opening in such plate.

884,106. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed May 7, 1906. Has a plurality of inductively related oscillation circuits in a succession of series between the aerial and the detector.

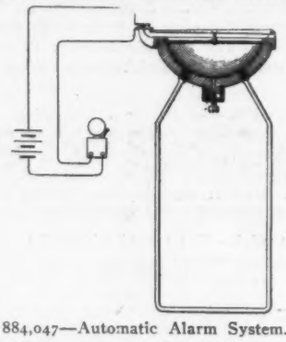
884,107. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1908. In a space telegraphy receiving system, an elevated conductor system comprising a parallel branch circuit including capacity in one branch and inductance in the other branch, an elevated conductor and an earth connector; said elevated conductor and earth connector being connected in parallel with respect to said parallel branch circuit.

884,108. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1906. Relates to modifications of the above.

884,109. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1906. Relates to additional modification of the above.

884,110. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass., and Sewall Cabot, Brookline, Mass. App. filed Jan. 4, 1907. Covers further modification of the above.

884,116. ELECTRIC IGNITION SPARK COIL FOR GAS OR VAPOR ENGINES; E. Q. Williams, Syracuse, N. Y. App. filed Dec. 28, 1904. Relates to several features of induction coils, including a form of vibrator clamping and also certain metallic locking screws by which



884,047—Automatic Alarm System.

the electrical connections are made when a coil unit is dropped into and clamped in its receiving box.

884,121. AUTOMATIC ELECTRIC ALARM FOR BEDS TO BE OCCUPIED BY PATIENTS, SUCH AS HOSPITAL BEDS; Frank Apold, of Philadelphia, Pa. App. filed Aug. 4, 1906. Automatic electric alarm for use in hospital beds to indicate movements of the patient which should be called to the attention of the physician.

884,124. PROCESS FOR THE LECTROLYSIS OF FLUID SALTS OR COMPOUNDS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Jan. 2, 1907. A process for dissociating alkali salts or compounds into their acid and basic constituents by electrolysis.

884,129. ELECTRIC SIGNAL; Arthur J. Cleveland and Frank S. Brown, Minneapolis, Kansas. Makes use of a special trolley conductor adjacent the track rail and which is engaged by a shoe depressible by a lever in the locomotive cab.

884,130. ELECTRIC TIME SWITCH; James Joseph Coachman, London, England. App. filed July 18, 1905. A device whereby an electric contact is made or broken after the lapse of a given time. Makes use of a weighted piston which has its movement impeded by a fluid.

884,142. INSULATOR; Ernest Jay Foreman, Trinidad, Col. App. filed Nov. 2, 1906. A cylindrical porcelain insulator deeply grooved on one side to receive the line conductor, and having additional grooves in which binding wires are received.

884,158. SYSTEM OF AUTOMATIC BLOCK SIGNALING FOR ELECTRIC RAILWAYS; Winthrop K. Howe, Buffalo, N. Y. App. filed Sept. 28, 1906. A signaling system having an alternating current generator and separate means connected therewith to produce a difference of potential across the rails and a continuity current along the rails of a block section.

884,170. THIRL RAIL ELECTRIC RAILWAY SYSTEM; Charles Kozesnik, of ———. App. filed Dec. 17, 1907. A form of third rail for electric systems, having insulated sections, which are energized during the passage of a train by switches which are actuated magnetically.

884,224. RAILWAY SIGNAL; John S. Sims, Longbeach, Cal. App. filed March 22, 1907. Mechanical features of a semaphore signal having an oscillating arm moved through a rack and pinion connection with the armature of an electromagnet. Circuits are shown adapted to illuminate a signal lamp.

884,235. RECEIVER FOR TELEPHONES; Louis Steinberger, New York, N. Y. App. filed Feb. 18, 1907. A form of bi-polar telephone receiver having a cap which automatically locks itself in its tightened relation so that it cannot be unscrewed by unauthorized persons. Has a special form of resonance sound chamber.

884,264. STORAGE BATTERY; Georgie A. Carpenter, New York, N. Y. App. filed April 4, 1907. A form of storage battery plate making use of a lead inclosing box filled with active material. The arrangement is designed to give an equal area in the positive and negative plates.

884,271. ELECTRIC LIGHT SOCKET; Franz Frankofski, North Braddock, Pa. App. filed Sept. 12, 1907. Requires a special incandescent lamp and receiving socket. The parts have co-operating pawls or dogs which secure an interlocking engagement which cannot be released without breaking the bulb.

884,296. ELECTRIC CURLING IRON; Clara A. Richards, Portland, Ore. App. filed Oct. 15, 1907. The bar of the curling iron is made hollow and contains a resistance element adapted to an incandescent lamp circuit. Has a detachable plug connection with lamp circuit.

884,304. FIRE ALARM; Albert S. Trask, Concord, N. H. App. filed May 14, 1907. A thermostat for fire alarm systems including a pair of spring blades which are held apart by a strip of solder which will melt and permit the engagement of the blades in case of fire.

884,312. ELECTRICAL CONNECTOR; James L. Carnall, New York, N. Y. App. filed Dec. 14, 1907. A device for tapping-in an electrical device or instrument; for example, an extra or special key in a telegraph system. Relates to mechanical features of construction.

884,343. ELECTRIC WATER HEATER; Herbert N. Roche, San Francisco, Cal. App. filed March 28, 1907. A cylindrical casing is made part of the water circulatory system and contains an interior cylindrical chamber having resistance coils. The device includes an electric lamp which glows whenever the current is turned on.

884,345. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed Oct. 26, 1907. Has two blow-out magnets, the pole pieces of which form bearings for the controller shaft.